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### Fabrication and characterization of CNT/Ni/TiN/Si bridge structures.

### Report 2014-03

Prepared by: *Plasmionique Inc.*Lab: 1650 boul. Lionel Boulet
Varennes, Québec
Canada J3X 1S2

Jean-Baptiste A. Kpetsu, ing., M.Sc.

Andranik Sarkissian, PhD

PBN: 14297 8295 RN0001 Tel: (450) 929 8154 Fax: (450) 929 8102 for **DRDC Valcartier** 

CSA: Philips Laou, PhD (418) 844-4000 x4218 Suzanne Paradis, ing., M.Sc. Philippe Mérel, PhD

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**CONTENTS** 

1. Fabrication of CNT/Ni/TiN/Si bridge structures	3
1.1. SOI Batch #3A, Sample CTSoi-14N (Follow-up, complete)	
1.2. SOI Batch #3B, Process flow #3B (New, complete)	
1.3. SOI Batch #4A, Process flow #4A (New, started)	3
1.4. SOI Batch #5A, Process flow #5A (New, started)	4
2. Characterization of potentially good CNT bridges	4
2.1. Thickness measurement (CNT and Si bridge)	4
2.2. CNT growth area measurement	6
2.3. Mass measurement of CNT film	6
Bibliography	9
Annex 1: Samples characteristics and follow-up tables (#10)	10
Annex 1A: Sputter deposition with the "CVC New-Sputter"	11
Annex 1B: CNT growth with the PECVD system	13
Annex 1C: Sputter deposition with the "Plasmionique SPT330" system	14
Annex 1D: Lithography processes	15
Annex 1E: Wet etching/cleaning processes	29
Annex 1F: Plasma etching/cleaning with Tegal T901e RIE system	40
Annex 1G: Microwave Plasma ashing/stripping with PLASMA-PREEN II-973 system	55
Annex 2: Batch #3A - Sample CTSoi-14N (completed)	56
Annex 3: Batch #3B - Sample CTSoi-13bN	
Annex 4: Batch #3B - Sample CTSoi-14bN	
Annex 5: Batch #3B - Sample CTSoi-14cN	
Annex 6: Batch #3B - Sample CTSoi-15N	60
Annex 7: Batch #3B - Sample CTSoi-19N	61

### 1. Fabrication of CNT/Ni/TiN/Si bridge structures

### 1.1. SOI Batch #3A, Sample CTSoi-14N (Follow-up, complete)

CNT bridge fabrication results for SOI Batch #3A samples were shown in last report, except for the particularly promising sample TSoi-14N which was planned to be cleaned using a new microwave plasma ashing method prior to CNT growth. Although the MW plasma ashing wasn't successful in removing the remaining burnt/popped photoresist on the sample, aligned CNT were obtained for the first time on this sample's previously broken Bridge #3 (Figure 1). However, Bridges #1 and #2 also collapsed before the CNT growth making CTSoi-14N unsuitable for electrical/thermal characterization. Last MW stripping, lithography, and CNT growth process parameters are available in the follow-up tables of (Annex 1, Annex 1B), (Annex 1, Annex 1D), and (Annex 1, Annex 1G) respectively for this sample. Photomicrographs and SEM micrographs of the CNT bridge are added for those last fabrication steps in Annex 2.

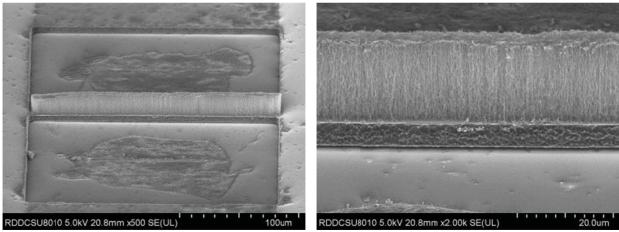


Figure 1: SOI Batch #3A, Process flow #3A: SEM images of CTSoi-14N broken Bridge#3 with aligned CNTs

### 1.2. SOI Batch #3B, Process flow #3B (New, complete)

The CNT bridge fabrication for the five SOI Batch #3B samples (CTSoi-13bN, CTSoi-14bN, CTSoi-14cN, CTSoi-15N, and CTSoi-19N) was performed using the related process flow described in the second to last report. Precise process parameters and data are available in the follow-up tables of (Annex 1, Annex 1A) for deposition with the CVC sputter, (Annex 1, Annex 1B) for CNT growth with the PECVD, (Annex 1, Annex 1D) for lithography processes, (Annex 1, Annex 1E) for wet etching processes, (Annex 1, Annex 1F) for dry etching processes with the Tegal T901e RIE, and (Annex 1, Annex 1G) for resist ashing/stripping with the Plasma-Preen. Photomicrographs and SEM micrographs are provided at the various process flow steps for the samples in Annex 3, Annex 4, Annex 5, Annex 6, and Annex 7. Many CNT bridges of this batch appear to be potentially good and are further analyzed in the characterization section.

### 1.3. SOI Batch #4A, Process flow #4A (New, started)

The process flow #4A was also described in the second to last report and 5 samples (TSoi-11, TSoi-11b, TSoi-12b, and TSoi-18) are being processed accordingly. First already

available process data are also included in the follow-up tables of Annex 1 but since the fabrication is still ongoing, main results are only expected for next report. Preliminary tests already indicated that stiction between the early released Si bridge and the handle underneath might be one of the main challenges for this process flow.

### 1.4. SOI Batch #5A, Process flow #5A (New, started)

This batch of samples has been started lately using the new SOI prime wafers that have been received with device nominal thickness of  $3\pm0.5\,\mu m$  and a BOX nominal thickness of 1  $\mu m$   $\pm0.5\%$ . The CNT bridge fabrication is however currently on hold as the precise process flow to use will be determined from ongoing first characterization and analyses of previous batch results.

### 2. Characterization of potentially good CNT bridges

Volume (thickness and growth area) and mass measurements are being performed on some selected CNT samples to help estimate their CNT density. Densities of  $\sim$ 2-3% are reported in the literature for SWCNT films 10  $\mu$ m thick but could vary a lot depending on sample preparation conditions [1]. Thermal conductivity measurements are also to be performed once the experimental setup is ready. Room temperature thermal conductivity values in the extremely wide range of  $\sim$ 0.7-6600 W/m K are reported for individual and bulk single wall and multiwall CNTs [2], [3].

### 2.1. Thickness measurement (CNT and Si bridge)

The CNT layer thickness was estimated using various tools:

- Veeco optical profiler appears unsuitable for this kind of measurements due to the high difference of reflectivity between the CNT layer and the surrounding layers (TiN electrodes and Si Handle). The low reflectivity of the CNT layer makes the bridge appear as a hole in the whole structure (Figure 2).

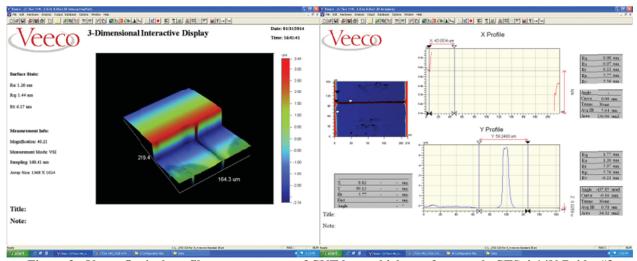


Figure 2: Veeco Optical profiler measurement of CNT layer thickness for sample CTSoi-14N Bridge#3

- Nikon Eclipse LV150 optical microscope was used to measure the stage displacement required (in the vertical Z-direction) to focus respectively on the top surface (Tip) and bottom (TiN layer) of the CNT film. Since the Z-displacement knob graduation is in arbitrary units, the system has to be calibrated for the conversion of this graduation unit into standard length units. A first calibration was done using an available Veeco Step Height Standard (SHS) which was known to have a height of 8.374 μm. The challenge was however to know exactly when the focus was on the top of the step and in the trench. Calculated conversion factors are shown in Table 1 and hence estimated thicknesses for the samples' CNT layers are shown in the second to last column of Table 2.

Table 1: Veeco SHS based Z-displacement conversion factor for the Nikon LV150 optical microscope stage

Sample name	Date	Nikon Eclipse LV150 microscope Objective	Stage moving Up or Down	Trench Level (grad) = Knob Graduation Unit	Step Level (grad) = Knob Graduation Unit	Step Height (grad) = Knob Graduation Unit	Conversion factor (μm/grad) - From SHS known 8.374 μm height	Comments
Veeco (SHS)	14/02/17	X50	Down	77	47	30	0.279	This estimation of the Z-displacement conversion factor for the Nikon Eclipse LV150 stage is done using an 8.374µm-high Veeco Step Height Standard (SHS).
		X50	Up	77	45	32	0.262	idem
		X100	Down	81	52	29	0.289	idem
		X100	Up	82.5	51	31.5	0.266	idem

- A second calibration of the Nikon Eclipse LV150 optical microscope stage Z-displacement was done for each sample by measuring an additional reference distance that could also be easily measured using the Dektak 150 stylus profiler. The depth of the trench (TiN + Device layer + BOX) around each bridge was therefore measured using both methods and a conversion factor was calculated for each bridge. The challenge was also to know exactly when the focus was on the handle, the TiN surface and the CNT tip. Calculated conversion factors and estimated CNT thicknesses are shown in Table 2.
- SEM measurements of the CNT layer thickness were also performed on the samples by tilting them as much as possible (65-70°). Raw measurements indicated on SEM images in Annex 2, Annex 3, Annex 4, Annex 5, Annex 6, and Annex 7 are to be corrected afterward for the tilting angle as the SEM automatic tilt-compensation was shown to distort images only in an in-plane direction, leading to false CNT thickness measurements when used. Corrected average CNT thicknesses are shown in Table 2. Definite tip delimitation for aligned CNT samples (CTSoi-14N) leads to more reliable measurements than the unclear delimitation of the top surface of all other analyzed samples which CNTs are spaghetti-like.

Veeco SHS based estimations are seen to be completely out of range with Dektak and SEM based estimations. In fact tilt-corrected SEM measurements are thought to be more reliable as they are less operator-related.

The thicknesses of the Si bridges (device layers) are also estimated using the Dektak 150 and SEM measurements as shown in Table 3.

### 2.2. CNT growth area measurement

Theoretical dimensions of the Ni masks (6  $\mu$ m X 54  $\mu$ m; 6  $\mu$ m X 104  $\mu$ m; 6  $\mu$ m X 204  $\mu$ m) could be used to estimate CNT surface coverage on the bridges. However, more precise and direct measurements were performed using a useful surface measurement feature found in NIS-Elements image analysis software. Those measurements of CNT growth areas allow for taking into account fabrication-related defects as indicated in the optical images of Annex 2, Annex 3, Annex 4, Annex 5, Annex 6, and Annex 7.

For electrical/thermal characterization purposes, it should be noted that the effective CNT surface coverage might be slightly smaller than measured in some particular cases depending on the fabrication process flow used. Especially, when the TiN electrode layer is patterned and etched before Ni deposition and lift-off, Ni might also be deposited directly on the Si in TiN defect areas leading to CNT/Ni/Si growth which should not be accounted for in electrical signal from CNT/Ni/TiN/Si areas. CNT surface coverage data are available in Table 3.

### 2.3. Mass measurement of CNT film

The CNT film mass measurement was performed using a *Sartorius Supermicro* 4 microbalance which was found in the Chemistry Laboratory of DRDC WS Section. This microbalance has a specified readability (resolution) of 0.1 µg. For practical operating reasons, the total sample (CNT + substrate) size and mass should not exceed approximately 2 cm X 2 cm and 400 mg respectively. The CNT weight is estimated by comparing the weight of the substrate before and after removing the CNT film.

The first measurement performed on a CNT test sample (CS093-3N) yield 77.6  $\mu$ g for CNTs covering an area of ~1 cm². If such CNTs were on the Ni/TiN/Si bridges, they would have weighed between 0.25 ng and 0.95 ng respectively for the shortest and longest bridge. Those values are at least two orders lower than the resolution of the microbalance and that means there's no point trying to measure directly CNT mass on real CNT bridge samples. Witness samples will therefore be used to estimate the CNT mass on the bridges. Moisture could affect seriously measurements with the microbalance and therefore special care should be taken with the CNT layers which are highly porous.

SEM	CNT thickness (µm) - From SEM measurements		2.282	2.282	17.923	17.923		0.845	0.845	1.266	1.266	1.386	1.386	1.125	1.125	1.221	1.221	1.291	1.291	0.898	868.0	1.583	1.583
and	CVT thickness (µm) - From measured Veeco SHS standard conversion factor		1.155	0.864	5.775	5.250		0.794	0.731	1.011	0.798	0.758	0.399	0.578	0.665	0.650	0.731	0.722	0.598	1.155	0.930	0.794	0.665
n factor	CVT thickness (µm) - From Dektak-based conversion factor		2.940	2.606	22.050	21.774		2.438	2.276	3.833	2.738	2.126	1.869	1.812	2.398	2.128	2.754	2.468	2.539	4.426	3.339	4.587	2.919
onversi	CVT thickness = TiN to CVT surface distance (grad) = Knob Graduation Unit		4	3.25	20	19.75		2.75	2.75	3.5	3	2.625	1.5	2	2.5	2.25	2.75	2.5	2.25	4	3.5	2.75	2.5
LV150 optical microscope (with Dektak and SHS based Z-displacement conversion factors)	Conversion factor (µm/grad) - From Dektak measurement of Si-TiN distance		0.735	0.802	1.102	1.102		0.887	0.827	1.095	0.913	0.810	1.246	906.0	0.959	0.946	1.001	0.987	1.128	1.107	0.954	1.668	1.168
Z-displa	Si Handle to TiN surface distance (µm) - Dektak measurement		2.205	2.205	5.788	5.788		3.103	3.103	5.476	5.476	4.049	4.049	4.076	4.076	4.256	4.256	3.949	3.949	6.916	6.916	2.919	2.919
based 2	Si Handle to TiN surface distance (grad) = Knob Graduation Unit		3	2.75	5.25	5.25		3.5	3.75	5	9	5	3.25	4.5	4.25	4.5	4.25	4	3.5	6.25	7.25	1.75	2.5
nd SHS	Z-stage Knob graduation - Focus on CNT surface : Average		61.5	62.5	62.5	62.75		69	70	80.5	80.75	80.375	82	86.5	87	89.75	90	95.5	96.25	73	73.5	94.25	94.5
ektak a	- stage Knob graduation - Focus on CNT surface : 2nd		61	63	61	64		68.75	71	79.5	81.5	80	82.5	98	87.5	89.5	90.5	95	96.5	71	75	93.5	95
(with D	Z-stage Knob graduation - Focus on CNT surface : 1st		62	62	64	61.5		69.25	69	81.5	80	80.75	81.5	87	86.5	06	89.5	96	96	75	72	95	94
roscope	Z-stage Knob graduation - Focus on TiV surface : Average		65.5	65.75	82.5	82.5		71.75	72.75	84	83.75	83	83.5	88.5	89.5	92	92.75	86	98.5	77	77	26	97
cal mic	- stage Knob graduation - bns : 52 state Knob Zing - 52 state		59	99	82	83		17	73.5	83.5	84.5	82.5	84	88	90	91.5	93.5	5.76	66	76.5	2.77	5.96	97.5
150 opti	Z-stage Knob graduation - Focus on TiV surface : 1st		99	5.59	83	82		72.5	72	84.5	83	83.5	83	68	89	92.5	65	5.86	86	77.5	2.92	97.5	96.5
- 1	-stage Knob graduation - Nverage Focus on Si handle : Average		68.5	68.5	87.75	87.75		75.25	76.5	68	89.75	88	86.75	93	93.75	96.5	26	102	102	83.25	84.25	98.75	99.5
ing Nil	- stage Knob graduation - Focus on Si handle : 2nd		89	5.89	87	88.5		74.5	77	88.5	5.06	87.5	87.5	92	94.5	96	5.76	101.5	102.5	82.5	85	86	100
ation u	Z-stage Knob graduation - Focus on Si handle : 1st		69	68.5	88.5	87		92	9/	89.5	68	88.5	98	94	93	26	96.5	102.5	101.5	84	83.5	99.5	66
s estim	Stage moving Up or Down		Down	Up	Down	Up		Down	Up	Down	$^{\mathrm{Up}}$	Down	$^{\mathrm{Up}}$	Down	$\mathbf{Op}$	Down	Up	Down	$^{\mathrm{Up}}$	Down	Up	Down	$\mathbf{Up}$
nicknes	Nikon Eclipse LV150 microscope Objective		X100	X100	X100	X100		X100	X100	X100	X100	X100	X100	X100	X100	X100	X100	X100	X100	X100	X100	X100	X100
NT th	# noitsoffinebi egbird		1		3			2		1		2		1		2		3		2		2	
Table 2: CNT thickness estimation using Nikon	<b>Затріс пате</b>	↓BATCH #3A	CTSoi-13N		CTSoi-14N		↓BATCH #3B	CTSoi-13bN		CTSoi-14bN		CTSoi-14bN		CTSoi-14cN		CTSoi-14cN		CTSoi-14cN		CTSoi-15N		CTSoi-19N	

	Соттепія		Very thin and low density CNT layer on a lot thicker Si bridge. The bridge can however be used for thermal/electrical testing		Effective CNT surface might be slightly smaller than calculated since some CNTs are grown on a small Ni/Si area instead of the main Ni/TiN/Si area of the bridge (due to this process flow) - Good bridge with thin Si and thicker CNT layer.	Aligned CNTs on however broken bridge			Although the TiN layer exhibits a low resistance across the bridge, its continuity at one end of the bridge seems fragile! The bridge can be used for thermal/electrical pre-testing	Dense CNT layer but thinner than the Si bridge. Sample can be used for thermal/electrical testing	This Si bridge touches the handle on $\geq 1/3$ of its length. The CNT/Ni/TiN is sometimes detached from the Si, forming bumps at few locations on the bridge. The bridge can be used for thermal/electrical pre-testing	Dense, nonuniform CNT layer but thinner than the Si bridge. Sample can be used for thermal/electrical testing	Dense, nonuniform CNT layer but thinner than the Si bridge. Sample can be used for thermal/electrical testing	This Si bridge touches the handle on ≥1/2 of its length. Holes in TiN layer lead to nonuniform CNT layer. The bridge can be used for thermal/electrical pre-testing	The CNT grows in sparsely distributed spots. Although the TiN layer exhibits a low resistance across the bridge, its continuity at one end of the bridge seems fragile! The CNT/Ni/TiN is detached from the Si and forms a large bump at one end of the bridge. The bridge can be used for thermal/electrical pre-testing	This Si bridge touches the handle on ≥1/2 of its length. Dense CNT layer almost as thick as the Si bridge. The bridge can be used for thermal/electrical pre-testing
	Witness Samples Names (for density estimation)	↓ BATCH #2	CS145N (CNT, Ni)	↓ BATCH #3A	CS158N (CNT, Ni) - S160 (TiN)	CS163N (CNT) - S161N (Ni, TiN)		<b>U</b> BATCH #3B	CS160N (CNT, Ni, TiN)	CS160N (CNT, Ni) - S161 (TiN)	CS160N (CNT, Ni) - S161 (TiN)	CS162bN (CNT, Ni) - S161 (TiN)	CS162bN (CNT, Ni) - S161 (TiN)	CS162bN (CNT, Ni) - S161 (TiN)	CS162bN (CNT, Ni, TiN)	CS162bN (CNT, Ni, TiN)
-	TiN Resistance (ka) / Conductivity test across the bridge with 2 probes		1		0.555	203	diT →		0.849	0.5	1.174	0.42	0.585	568.0	99.0	0.343
nples	CAT Volume (µm x µm x µm) · From LV150 and SEM		359		829	3290 6	2154 3		446	386	803	262	661	1316	236	988
bridge samples	CVT surface (µm x µm) - From LV150 estimation		449		297	1836	1202		528	305	579	233	541	1020	263	999
_	CNT thickness (µm) - From SEM measurements		0.799		2.282	17.92 3	17.92 3		0.845	1.266	1.386	1.125	1.221	1.291	868.0	1.583
ood Cl	Si bridge thickness (µm) - From SEM measurements		7.829		0.916	5.032			1.810	4.660	2.795	3.088	3.294	2.919	6.731	1.647
tially g	Si bridge thickness (µm) - From Dektak estimation		6.507		1.086	4.68			1.99	4.368	2.941	2.968	3.148	2.841	5.816	1.819
ooteni	Buried Oxide -BOX- thickness Suried IN - SOI wafer substrate		1		1	1			1	1	1	1	1	-	1	-
cs of	TiN layer thickness (µm) - From Dektak		0.06 8		0.11	0.10			0.11	0.10	0.10	0.10	0.10	0.10	0.1	0.1
teristi	Si Handle to TiN surface distance (µm) - Dektak		7.575		2.205	5.788	5.788		3.103	5.476	4.049	4.076	4.256	3.949	6.916	2.919
ıarac	# поітвайінарі эдрілЯ		2		1	3			2	1	2	1	2	3	2	2
Table 3: Characteristics of potentially good CNT	<b>Sample пате</b>	↓ BATCH #2	CTSoi-02N	↑ BATCH#3A	CTSoi-13N	CTSoi-14N		† BATCH#3B	CTSoi-13bN	CTSoi-14bN	CTSoi-14bN	CTSoi-14cN	CTSoi-14cN	CTSoi-14cN	CTSoi-15N	CTSoi-19N

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# Annex 1: Samples characteristics and follow-up tables (#10)

Nomenclature for samples in the following tables:

Si substrate with identification number 0X (SN0X for old samples).

SOI (Silicon on insulator substrate with identification number 0X). Soi-0X

**ALN01**: Bare Al<sub>2</sub>O<sub>3</sub> substrate, number 01.

**Fi-0X**: Si substrate with Ti coating, number 0X.

Ti coating, on a special substrate (Bolo9 is the name of a device prototype used as substrate). Bolo9Ti:

Si substrate with a thermally grown oxide layer at 1000 °C in O<sub>2</sub>, number 01. SX01:

**Solution** Si substrate with TiN coating, number 012.

**TSoi-02**: SOI substrate with TiN coating, number 02.

**AL07**: Al<sub>2</sub>O<sub>3</sub> substrate with TiN coating, number 07.

 $Si_3N_4$  film with identification number 0Y deposited on an identified substrate. SiN-0Y

SiO<sub>2</sub> film with identification number 0Z deposited on an identified substrate. SiO-0Z

VO<sub>x</sub> film with identification number XX deposited on an identified substrate. V02-XX :

**YBCO-YY**: Y-Ba-Cu-O film with identification number YY deposited on an identified substrate.

**Bolo5-YBCO**: Y-Ba-Cu-O coating, on a special substrate (Bolo5 is the name of a device prototype used as substrate).

SX18N: SX18 with Ni coating.

S100N: S100 with Ni coating.

SN11 (Si substrate) with Ni coating, (usually for Ni calibration). SN11N:

**ALN02N**: ALN02 with Ni coating.

TSoi-02 with Ni coating or being patterned (lithography) prior to the Ni coating for lift-off. TSoi-02N:

CS100N: CNT grown on S100N

CALN28N: CNT grown on ALN28N.

Plasma etching of sample Ti-18 using the Plasmionique SPT330 sputter. Ti-18 pe:

Plasmionique Inc.

Annex 1A: Sputter deposition with the "CVC New-Sputter"

Comments	3h10 pumping		3h10 pumping		3h10 pumping		Overnight pumping		Overnight pumping		Overnight pumping		Overnight pumping		1h50 pumping
Тріскпеss (nm) Ellipsometry		3.89		3.89		3.89		3.89		3.89		3.89		3.89	
Thickness (nm) Dektak															120
Deposition Total Pressure - Pfeiffer - Pirani (mTorr)	6.87	2.12	6.87	2.12	6.87	2.12	6.9	2.08	6.9	2.08	6.9	2.08	6.9	2.08	2.21
Deposition Total Pressure - Varian - ConvecTorr (mTorr)	10	1.6	10	1.6	10	1.6	10	1.6	10	1.6	10	1.6	10	1.6	3.8
Deposition Total Pressure - Varian - CDG (mTorr)	13	1.7	13	1.7	13	1.7	13	1.7	13	1.7	13	1.7	13	1.7	2.6
Deposition Total Pressure - MKS - Baratron (mTorr)	5.73	92.0	5.73	92.0	5.73	92.0	5.74	0.75	5.74	0.75	5.74	0.75	5.74	0.75	1.19
Ar flow (seem)	10	30	10	30	10	30	10	30	10	30	10	30	10	30	0
O2 flow (seem)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(moos) wost betsulbe 2N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48.3
Current in DC mode (A)															0 7 0 9
DC Bias in RF mode or Voltage in DC mode (V)	-738	-825	8£2-	-825	-738	-825	<i>L</i> £ <i>L</i> -	188-	L£L-	188-	<i>L</i> £ <i>L</i> -	188-	-737	-831	484
(mim) əmiT gnirəttuq8	0	3.5	0	3.5	0	3.5	0	3.5	0	3.5	0	3.5	0	3.5	0
Presputtering Time (min)	20	5	20	5	20	5	20	5	20	5	20	5	20	5	30
Reflected Power (W)	S	4	5	4	5	4	9	4	9	4	9	4	9	4	0
Sputtering Power (W)	101	101	101	101	101	101	101	101	101	101	101	101	101	101	100
Temperature Setpoint (°C)															
( <sup>O</sup> °) Уелрегатиге (ОС)															
Base Pressure - Varian - Ion Gauge (Torr)	3.7E- 07		3.7E- 07		3.7E- 07										4.1E- 07
Base Pressure - Pfeiffer - Cold Cathode (Torr)	2.9E- 07		2.9E- 07		2.9E- 07		1.8E- 07		1.8E- 07		1.8E- 07		1.8E- 07		3.2E- 07
Toggle Velocity	3		3		3		3		3		3		3		3
(°X±) əlgnA-YlkH əlggoT	45		45		45		45		45		45		45		10
Substrate (If in rotation)	TSoi- 13b	ı	TSoi- 14b	1	<u>S160</u>	1	TSoi- 14c	ı	TSoi- 15	ı	TSoi- 19	,	S162'	,	holder
Sanstaid Distrate Distance (m2)	10		10		10		10		10		10		10		10
Target	Z		Z		Z		Z		Z		Z		Z		TiN
Mode: DC or RF (Contactor/Generator 1 or 2)	RF- 1		RF-1		RF- 1		RF- 1		RF- 1		RF- 1		RF-		DC-
Gun/Target diameter (")	4		4		4		4		4		4		4		2
Cun Number	8		8		8		8		8		8		8		-
New-Sputter (NS) Plasmionique sputter (SPT)	SN		SN		SN		SN		SN		SN		SZ		S
Date	13/11/04						13/11/05								13/11/25
Затріс пате Затріс пате	TSoi- 13bN		TSoi- 14bN		S160N		TSoi- 14cN		TSoi- 15N		TSoi- 19N		S162bN		TiN

	T		1 1
гзиэттоЭ	4h00 pumping; New 4" SOI substrate; DHF preclean; For samples TSoi-39 Heating (500 deg initially) lost at 20 min due to bad cable connection. Temperature down to 150 deg at the end. Not to be used for devices	Overnight pumping; New 4" SOI substrate; DHF preclean; For samples TSoi-20 to TSoi-29. Heating OK. Good sample with goldish color. Use for devices as SOI Batch#5	Overnight pumping
Thickness (nm) Ellipsometry			
Тһіскпеѕѕ (nm) Dекtак	100	100	
Pfeiffer - Pirani (mTorr)	2.31	2.28	6.84
Varian - ConvecTorr (mTorr)  Deposition Total Pressure -	3.8	3.7	10 6
Varian - CDG (mTorr) Deposition Total Pressure -	2.6	2.5	13
MKS - Baratron (mTorr) Deposition Total Pressure -	81.1	1.17	5.74
Deposition Total Pressure -			
ук. цом (гесш)	0	0	10
O2 flow (seem)	0	3	0
(moss) wolf betset flow (seem)	48.3	48.3	0
(A) abom Od in Trurent in DC mode (A)	0 7 7 1 0 1	0.0111111111111111111111111111111111111	
DC Bias in RF mode or Voltage in DC mode (V)	494	494	-735
(mim) amiT gnirəttuq&	40	40	0
(nim) əmiT gnirəttuqsər4	15	15	30
Reflected Power (W)	0	0	5
Sputtering Power (W)	100	100	101
Temperature Setpoint (°C)	¢.	500	
Real Temperature (°C)			
Base Pressure - Varian - Ion Gauge (Torr)	3.2E- 07		
Base Pressure - Pfeiffer - Cold Cathode (Torr)	2.3E- 07	1.7E- 07	7.8E- 07
Tricole Velocity	n	$\omega$	3
(°X±) əlgnA-tlaH əlggoT	10	10	45
Substrate (If in rotation)	<u>Soi-30</u>	<u>Soi-20</u>	Holder
Target→Substrate Distance (m2)	10	10	10
Target	Z.Z.	TiN	ï
(Contactor/Generator 1 or 2)	1 1		RF-
Gun/Target diameter (") Mode: DC or RF	2 D	2 D	
Gun Number			8 4
Plasmioniaue sputter (SPT)	SZ SZ	SZ	SN
New-Sputter (NS)			$\vdash$
Date	13/11/27	13/11/28	13/12/06
<b>Затр</b> је пате	TSoi-30 to TSoi-39	TSoi-20 to TSoi-29	Ni Clean

Plasmionique Inc.

Annex 1B: CNT growth with the PECVD system

oilnii ni vədmuV) sinəmmoO = estimation based on previous meassurements)								PECVD: Heater Power supply fusible burnt and changed for temporary fusible. Mechanical pumps fusible burnt and changed too. Water leak from the cryopump compressor.	Aligned CNTs from SEM observation
Тһіскпезя (пт)									16700
Deposition Gas C2H2 (%)									
Deposition Gas CH4 (%)	20	20	20	20	20	20	20		20
Deposition Gas H2 (%)	80	80	80	80	80	80	80		80
Deposition Gas Ar (%)									
Deposition Gas N2 (%)									
Deposition Pressure (mTorr)	0009	0009	0009	0009	0009	0009	0009		0009
Deposition Temperature (°C)	700	700	700	700	700	700	700		700
Deposition Time (min)	20	20	20	20	20	20	20		30
WM Power (W)	900	006	006	900	006	006	006		006
Substrate holder (PECVD)	BN	BN	BN	BN	BN	BN	BN		BN
Substrate	TSoi- 13bN	S160N	TSoi- 14bN	TSoi- 14cN	TSoi- 15N	TSoi- 19N	S162bN		TSoi- 14N
waves entrance window	27	27	27	27	27	27	27		27
Base Pressure - Pfeiffer Gauge (Torr)	4.0E-07	4.0E-07	4.0E-07	4.0E-07	4.0E-07	4.0E-07	4.0E-07		2.1E-07
Date	13/11/26							13/12/09	14/01/28
səldmr2	CTSoi- 13bN	CS160N	CTSoi- 14bN	CTSoi- 14cN	CTSoi- 15N	CTSoi- 19N	CS162bN		CTSoi- 14N

Annex 1C: Sputter deposition with the "Plasmionique SPT330" system

No data available for this period.

## Annex 1D: Lithography processes

Comments	New Photomas k received on 2013- 110-18, with with relarged Si bridge to compensa te for undercut due to isotropic plasma etch. RRD KRD	Idem. RRU version. Cleaning.	First uncentere d mask. RRU version. Cleaning.	1st Negative tone PR
Vino JagraT (mm) gniqqiyt	Ne Pho	日内とい	G K B G E	1st Neg
Dektak measured step after				
dirite				
DI H2O rinse; N2 blow dry O2 Plasma Clean after wet	Z >	A 2	2 A	
Final solvent rinse (IPA,);	.; N2	IPA ; N2	IPA ; N2	
Immersion or Soak Time (s)				
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes				
(, 2011				
Remover Clean #2 (Microposit				
(c) and a many to have tarring	•	0	0	
Immersion or Soak Time (s)	120	120	120	
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	55	0\$	54	
(, 2011	oja a	eto e	e e	
Remover Clean #1 (Microposit	Aceto	Aceto	Aceto	
+ Blow dry (Yes/No)				
Initial Strip: Acetone rinse + IAA rinse before acetone dries				
temperature treated PR) prior				
AskM-favett (mn) Ask				
Dektak measured step atter				
Etch of exposed target layer				
Postbake (nm)  Coating for Lift-off - Wet/Dry				
Dektak measured step after				
Short U2 Plasma De-scum (cleans thin resist left by dev.)				
Short O2 Plasma De-scum				
development (nm)  Postbake: Hotplate or Oven				
Dektak measured step after				
Immersion or Soak Time (s)				
Bath Temperature (°C) - For MF-319, 15-20°C is hest				
(, HAMT, HO <sub>6</sub> N, 125\				
Developer (Microposit MF-319				
Exposure Time Duration (s)				
(Zm2/Vm)				
intensity I-line=365nm: CI2: CP Power (W) or CI Intensity				
input power; CII:constant				
Softbake Time Duration (s)				
O°) synnerafure (°C)				
Speed #2 (rpm) Speed #2 (rpm)				0 0
Spin Speed #1 (rpm)				0 0
Promoter, Polyimide,				HMD
Hotplate Temperature (°C) Resist, Primer / Adhesion				
Dry/Dehydration bake:				20 0
	9			
Date	13/10/			
arran and arran	MAS K-2	3	1.5	- <u>i</u> Z
Sample name	K-	MAS K-3	MAS K-1	TSoi- 13bN

Comments	litho for Ni lift- off.		Double coat. Bad alignment . Strip + restart	Photomas k	2nd Negative tone PR litho for Ni lift- off.		Double coat. Bad alignment . Strip + restart	3rd Negative tone PR litho for Ni lift- off.	Single coat. Bad alignment
Dektak measured step after Stripping (nm) Target only	lithe Ni 1 off.		O S E S. 2	PI K	2 X 3 E X 2		C C all	£ N 5: N 20	S. C. B.
O2 Plasma Clean after wet strip			RI				RI E		RI E
Final solvent rinse (IPA,); DI H2O rinse; N2 blow dry			IPA ; N2	IPA ; N2			IPA ; N2		IPA ; N2
Immersion or Soak Time (s)									
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes									
Remover Clean #2 (Microposit 1165,)									
Immersion or Soak Time (s)			120	009			300		300
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes			<b>2</b> F	T T			A T		a T
Remover Clean #1 (Microposit 1165,)			Aceto	Aceto			Aceto		Aceto
PA rinse defore acetone dries + Blow dry (Yes/No)									
Initial Strip: Acetone rinse +									
Fich (nm), +Target -Mask 22 I tasina Otean (Fiasina) trign temperature treated PR) prior									
Etch of exposed target layer  Before of exposed target layer  Etch (nm) +Target layer									
Coating for Lift-off - Wet/Dry									
Dektak measured step after Postbake (nm)									
Temperature (°C) Short O2 Plasma De-scum (cleans thin resist left by dev.)									
Postbake: Hotplate or Oven									
Dektak measured step after development (nm)									
Immersion or Soak Time (s)			118				18		118
ro' - (O°) erafure (W) - For ts-319, 15-20°C is best			<b>2</b> L				R		Z L
Developer (Microposit MF-319 /321, NaOH, TMAH,)			ma- D533 S				ma- D533 S		ma- D533
Exposure Time Duration (s)			09				09		50
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)			6				6		6
input power; CII:constant			CI 1				CI 1		CI 1
Temperature (°C) Softbake Time Duration (s)			12 0				12 0		12 0
Softbake: Hotplate			16				16	_	0 0
Spin Speed #2 (rpm)		300	300		400	300	300	400	300
Spin Speed #1 (rpm)		0 0	50		06	50	50 0	06	0 0
Hotplate Temperature (°C) Resist, Primer / Adhesion Promoter, Polyimide,		ma- N141	ma- N141 0		HMD	ma- N141 0	ma- N141 0	HMD	ma- N141 0
Dry/Dehydration bake:					20 0			20 0	
Date					13/10/				
Sample name				MAS K-2	TSoi- 13bN			TSoi- 13bN	

sìnəmmoJ	. Strip + restart	4th Negative Itone PR litho for Ni lift- off.		Double coat. Fairly good alignment . Restart?			5th Negative tone PR litho for Ni lift- off.		Double coat. Quite good alignment
Stripping (mm) Target only									
Dektak measured step after									
DI H2O rinse; N2 blow dry O2 Plasma Clean after wet strip						A RI E			
Final solvent rinse (IPA,);						IPA ; N2			
Immersion or Soak Time (s)									
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes									
Remover Clean #2 (Microposit 1165,)									
Immersion or Soak Time (s)						300			
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes						R T			
Remover Clean #1 (Microposit 1165,)						Aceto ne			
+ Blow dry (Yes/No)									
Initial Strip: Acetone rinse + Initial Strips Acetone are Aries									
Fish (nm), the street of the prior temperature treated PR) prior									
Etch (nm) +Target layer									
Coating for Lift-off - Wet/Dry									
Dektak measured step after Postbake (nm)									
(cleans thin resist left by dev.)									
Temperature (°C) Short O2 Plasma De-scum									
development (nm)						-			
Dektak measured step after									
Immersion or Soak Time (s)				18 0	18				18 0
Bath Temperature (°C) - For MF-319, 15-20°C is hest				R T	R T				R T
Developer (Microposit MF-319 (, HAMH, TMAH,)				ma- D533 S	ma- D533 S				ma- D533 S
Exposure Time Duration (s)				09		18			09
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)				6		6			6
input power; CII:constant intensity I-line=365nm: CI2:				CI 1		CI 1			CI 1
Softbake Time Duration (s)				12 0					12 0
Softbake: Hotplate (2°) Sylvanerature				16					16
Spin Speed #2 (rpm)		400	300	300			400	300	300
Spin Speed #1 (rpm)		0	0	50			06	50	0 0
Resist, Primer / Adhesion Promoter, Polyimide,		HMD S	ma- N141 0	ma- N141 0			HMD	ma- N141 0	ma- N141 0
Dry/Dehydration bake : Hotplate Temperature (°C)		20 0					20		
Date							13/11/		
<b>Sample name</b>		TSoi- 13bN					TSoi- 13bN		

						R R or		ent	
Comments				Wet	RIE + Wet + RIE strips	1st Negative tone PR litho for Ni lift- off.		Double coat. Good alignment	
Stripping (mn) Target only				, 0					
strip Dektak measured step after					RI E				
DI H2O rinse; N2 blow dry O2 Plasma Clean after wet				4 . i 2 b	IPA ; July; NZ dry				
Immersion or Soak Time (s) Final solvent rinse (IPA,);									
at 80°C for 130-180°C bakes				T 0	2 30 F 0				
1165,)  Sath Temperature (°C) - 1165					0 R				
Remover Clean #2 (Microposit				Aceto	Aceto				
Immersion or Soak Time (s)				360	180				
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes				70	70				
Remover Clean #1 (Microposit 1165,)				PG	PG				
+ Blow dry (Yes/No)									
Initial Strip: Acetone rinse + IPA rinse before acetone dries									
temperature treated PR) prior				No	RIE				
Dektak measured step after <u>Fitch (nm), tean (fitsina) tugn</u>									
Coating for Lift-off - Wet/Dry Etch of exposed target layer Dektak measured step after			CV						
Postbake (nm)									
(cleans thin resist left by dev.)  Dektak measured step after			RI E						
Temperature (°C) Short O2 Plasma De-scum		01	- R						
Gevelopment (nm)		7	-						
Dektak measured step after									
MF-319, 15-20°C is hest Immersion or Soak Time (s)	18							18	18 0
Bath Temperature (°C) - For	R T							<b>~</b> F	A T
Developer (Microposit MF-319 (, MAMT, HO <sub>8</sub> D, 125)	ma- D533							ma- D533 S	ma- D533
Exposure Time Duration (s)		18						09	
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)		6						6	
input power; CII:constant		CI 1						CI 1	
Softbake Time Duration (s)								0 12	
Softbake : Hotplate (O°) Systematra								16	
Spin Speed #2 (rpm)						400	300	300	
Spin Speed #1 (rpm)						0	50	0 0	
Resist, Primer / Adhesion Promoter, Polyimide,						HMD S	ma- N141 0	ma- N141 0	
Dry/Dehydration bake : Hotnlate Temperature (°C)						20 0			
Date			13/11/	13/11/	13/11/	13/10/			
Sample name						TSoi- 14bN			

Comments			Wet strips	RIE + Wet + RIE strips	1st Negative tone PR litho for Ni lift- off.		Double coat. Good alignment			
			W, str	RIE Wet RIE strip	1st Neg tone lithe Ni 1					
Dektak measured step after Stripping (nm) Target only										
diris antie note bounseon Jethol				I S						
O2 Plasma Clean after wet				RIE						
Final solvent rinse (IPA,); UH H2O rinse; N2 blow dry			IPA DI; dry	PA DI; dry dry						
Immersion or Soak Time (s)			30	30						
at 80°C for 130-180°C bakes			<b>≃</b> ⊢	<b>≃</b> ⊢						
1165,) Bath Temperature (°C) - 1165										
Remover Clean #2 (Microposit			Aceto	Aceto						
Immersion or Soak Time (s)			360	180						
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes			70	70						
Remover Clean #1 (Microposit 1165,)			PG	PG						
+ Blow dry (Yes/No)										
Initial Strip: Acetone rinse + IPA rinse before acetone dries										
Fich (nm) that rested PR) prior treated PR) prior			No	RIE						
Etch of exposed target layer  Dektak measured step after  Freh (nm) +Torget -Mask										
Etch of exposed target layer		CV								
Postbake (nm)  Coating for Lift-off - Wet/Dry		0								
Dektak measured step after										
(cleans thin resist left by dev.)		RI E								RI E
Temperature (°C) Short O2 Plasma De-scum	0		ı	ı					0 0	
development (nm)	7								1	
Dektak measured step after										
Immersion or Soak Time (s)							18	18		
ME-319, 15-20°C is hest							Z L	2 L		
/321, NaOH, TMAH,)  Bath Temperature (°C) - For							. 6	3		
Developer (Microposit MF-319							ma- D53 S	ma- D53 S		
Exposure Time Duration (s)	18						09		18 0	
CP Power (W) or CI Intensity (mW/cm2)	6						6		6	
input power; CII:constant intensity I-line=365nm; CI2: CP Power (W) or CI Intensity	CI 1						CI 1		CI 1	
Softbake Time Duration (s)							0			
Temperature (°C)							0 0			
Speed #2 (rpm) Softbake : Hotplate					400	300	300			
(mqr) I# bəəq8 niq8					0 40	50 3(	0 30			
Promoter, Polyimide,										
Resist, Primer / Adhesion					HMD	ma- N141	ma- N141 0			
Dry/Dehydration bake : Hotnlate Temnerature (°С)					20 0					
Date	13/11/	13/11/	13/11/	13/11/	13/10/				13/11/	13/11/
<b>Sample пате</b>					TSoi- 14cN					
		1								

Соттепія	t ps	tt + + bps	1st Negative tone PR litho for Ni lift- off.		Double coat. Good alignment				t ps
function of the form	Wet	RIE + Wet + RIE strips	1st Neg tone lithe Ni 1		Doubl coat. Good alignn				Wet
Dektak measured step after Stripping (nm) Target only									
O2 Plasma Clean after wet dirts		RI E							
Final solvent rinse (IPA,); DI H2O rinse; N2 blow dry	IPA ; DI; N2 dry	IPA ; DI; N2 dry							IPA ; DI; N2 dry
Immersion or Soak Time (s)	30 0	30 0							0 0
at 80°C for 130-180°C bakes	A T	<b>8</b> F							<b>2</b> E
1165,) Bath Temperature (°C) - 1165	sto .	to sto							oto
Remover Clean #2 (Microposit	Aceto	Aceto							Aceto
(s) amiT AroS vo noisvammI	360	180							360
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	70	70							70
1165,)	PG	PG							PG
+ Blow dry (Yes/No) Remover Clean #1 (Microposit									
sairb anotase actone dries									
temperature treated PR) prior Initial Strip: Acetone rinse +	No	RIE							No
Fifth (nm) +Tarefi -Mask 1120	Z	R							Z
Etch of exposed target layer Dektak measured step after									
Coating for Lift-off - Wet/Dry	CA								CA
Dektak measured step after Postbake (nm)									
Temperature (°C) Short O2 Plasma De-scum (cleans thin resist left by dev.)								RI E	
Postbake: Hotplate or <u>Oven</u> Temperature (°C)	1	1					<u>10</u>		
Dektak measured step after									
Immersion or Soak Time (s)					18 0	18 0			
MF-319, 15-20°C is hest					<b>~</b> F	Z L			
/321, NaOH, TMAH,) Bath Temperature (°C) - For					ia- 533 5	1a- 533 S			
Developer (Microposit MF-319					ms D5	m D5			
(mW/cm2) Exposure Time Duration (s)					09		18		
intensity 1-line=365nm; CI2: CP Power (W) or CI Intensity					6		6		
input power; CII:constant					CI 1		CI 1		
Temperature (°C) Softbake Time Duration (s)					12 0				
Softbake: Hotplate					16				
Spin Speed #2 (rpm)			400	300	300				
Spin Speed #1 (rpm)			0 0	50	0 0				
Promoter, Polyimide,			HMD S	ma- N141 0	ma- N141 0				
Hotplate Temperature (°C) Resist, Primer   Adhesion			20 H 0	- 2	- 2				
<b>Dry/Dehydration bake:</b>	/	/.						/	
Date	13/11/	13/11/	13/11/					13/11/00	13/11/
Затріє пате Затріє пате			TSoi- 15N						
omon ofamos			TS 15						

Comments	RIE + Wet + RIE strips	1st Negative tone PR litho for Ni lift- off.		Double coat. Good alignment				Wet strips	RIE + Wet + RIE strips
Dektak measured step after Stripping (nm) Target only									
DI H2O rinse; N2 blow dry O2 Plasma Clean after wet strip	iPA ; RI DI; E N2 dry							IPA ; ; DI; N2 dry	IPA ; RI DI; E N2 dry
Immersion or Soak Time (s) Final solvent rinse (IPA,);	30 L 0 N d							30 L 0 N d	30 III d
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	T R							<b>≃</b> ⊢	<b>≈</b> ⊢
Remover Clean #2 (Microposit 1165,)	Aceto							Aceto	Aceto
Immersion or Soak Time (s)	180							360	180
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	70							70	70
Remover Clean #1 (Microposit )	PG							PG	PG
Initial Strip: Acetone rinse + IPA rinse before acetone dries + Blow dry (Yes/No)									
temperature treated PR) prior	RIE							No	RIE
Etch of exposed target layer Dektak measured step after Liftkinm) tenerget layer								ر د د	
Postbake (nm)  Coating for Lift-off - Wet/Dry								50	
(cleans thin resist left by dev.) Dektak measured step after							I		
Temperature (°C) Short O2 Plasma De-scum						<u>00</u>	RI - E	,	
development (nm) Postbake: Hotplate or Oven						1			
Immersion or Soak Time (s) Dektak measured step after				18 0	18 0				
MF-319, 15-20°C is hest				<b>2</b> F	<b>≃</b> ⊢				
Developer (Microposit MK-319) /321, NaOH, TMAH,) Bath Temperature (OO) - For				ma- D533 S	ma- D533 S				
Exposure Time Duration (s)				09		18			
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)				6		6			
input power; CII:constant				CI 1		CI 1			
Temperature (°C) Softbake Time Duration (s)				12 0					
<b>Softbake: Hotplate</b>				0 0					
Spin Speed #2 (rpm)		400	300	300					
Spin Speed #1 (rpm)		06 0	0 0	0 0					
Resist, Primer / Adhesion Promoter, Polyimide,		HMD	ma- N141 0	ma- N141					
Dry/Dehydration bake: Hotnlate Temperature (°C)		20 0							
Date	13/11/06	13/11/					13/11/	13/11/05	13/11/
<b>Затр</b> је пате		TSoi- 19N							

Соттепе	Litho for Ni/TiN/Si bridge release with Si and SiO2 etches	At bridge #2; idem + Si etch (RIE) + SiO2 etch (BHF)	At bridge #3; idem + Strip (RIE + Wet + RIE)	Litho for Ni/TiN/Si bridge release with Si and SiO2 etches	2nd litho because 1st litho was bad	3rd litho because 2nd litho was bad
Dektak measured step after Stripping (nm) Target only		310 3				547 6
O2 Plasma Clean after wet girth	Š	No.	No			RI
Final solvent rinse (IPA,); UH2O rinse; N2 blow dry	DI, N2	DI, N2	DI, N2	IPA ; DI; N2 dry	IPA ; DI; N2 dry	IPA ; DI; N2 dry
Immersion or Soak Time (s)						
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes						
(, 2911						
Remover Clean #2 (Microposit	0	0	0			0
at 80°C for 130-180°C bakes Immersion or Soak Time (s)	009	009	009			009
Bath Temperature (°C) -1165	70	70	70			70
Remover Clean #1 (Microposit 1165,)	1165	1165	1165			1165
IPA rinse defore acctone dries + Blow dry (Yes/No)				Aceto	Aceto	
Initial Strip: Acetone rinse +				Ac	Ac	
Fightom) + Tarest - Mask 111811 CA Trasina Cican (Trasina) prior	RIE	RIE	RIE			RIE
Etch (nm) +Target layer  Bektak measured step after						
Coating for Lift-off - Wet/Dry Etch of exposed target laver	RIE + Wet	RIE + Wet	RIE + Wet			RIE + Wet
Роваране (nm) Роваране (nm)	259	259	260			33
(cleans thin resist left by dev.)						
Postbake: Hotplate or Oven Temperature (°C) Short O2 Plasma De-scum	5					5
Dektak measured step after development (nm)						
Immersion or Soak Time (s)	50			50	20	20
Bath Temperature (°C) - For MF-319, 15-20°C is best	<b>≃</b> ⊢			A T	A T	A T
Developer (Microposit MF-319 /321, NaOH, TMAH,)	MF- 319			MF-	MF-	MF- 319
Exposure Time Duration (s)	20			20	21	20
CP Power (W) or C1 Intensity (mW/cm2)	19			19 6	19	19 6
input power; CII:constant intensity I-line=365nm: CI2: CP Power (W) or CI Intensity	CP			CP	CP	CP
Softbake Time Duration (s)	18			18	18	18 0
Softbake : Hotplate Temperature (°C)	11 8	-		111	111 5	11 &
Spin Speed #2 (rpm)	350			350	350	350
Spin Speed #1 (rpm)	0 0			50	50	0 0
Resist, Primer / Adhesion Promoter, Polyimide,	S182 2			S182 2	S182 2	S182 2
Dry/Dehydration bake: Hotnlate Temperature (°C)	20 0			20 0	20 0	20 0
Date	13/11/	13/11/		13/11/		13/11/
Затріс пате	TSoi- 13bN			TSoi- 14bN	TSoi- 14bN	TSoi- 14bN

Соттепія	At bridge #2; idem + Si etch (RIE) + SiO2 etch (BHF)	At bridge #3; idem + Strip (RIE + Wet + RIE)	Litho for Ni/TiN/Si bridge release with Si and SiO2 etches	At bridge #2; idem + Si etch (RIE) + SiO2 etch (BHF)	At bridge #3; idem + Strip (RIE + Wet + RIE)	Litho for Ni/TiN/Si bridge release with Si and SiO2
Dektak measured step after Stripping (nm) Target only	404 9		407	425 6	394 9	
Final solvent rinse (IPA,); DI H2O rinse; N2 blow dry O2 Plasma Clean after wet strip	IPA ; RI DI; E n2 dry	IPA ; RI DI; E N2 dry	IPA ; RI DI; E N2 dry	IPA ; RI DI; E N2 dry	IPA ; RI DI; E dry	IPA ; DI; E N2 dry
Remover Clean #2 (Microposit 1165,)  Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes Immersion or Soak Time (s)						
Immersion or Soak Time (s)	009	009	009	009	009	009
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	20	02	70	70	70	70
Remover Clean #1 (Microposit)	1165	1165	1165	1165	1165	1165
Initial Strip: Acetone rinse + IPA rinse before acetone dries + Blow dry (Yes/No)						
Figh (nm) + Farget - Mask in the state of th	RIE	RIE	RIE	RIE	RIE	RIE
Coating for Lift-off - Wet/Dry  Etch of exposed target layer  Dektak measured step affer  Etch (nm) +Target -Mask	RIE + Wet	RIE + Wet	RIE + Wet	RIE + Wet	RIE + Wet	RIE + Wet
(cleans thin resist left by dev.) Dektak measured step after Postbake (nm)	283	271	257	3	262 8	5 5
Postbake: Hotplate or Oven Temperature (°C) Short O2 Plasma De-scum			111			111
development (nm) Dektak measured step after						
MF-319, 15-20°C is hest Immersion or Soak Time (s)			50			50
Bath Temperature (°C) - For			A T			T T
Developer (Microposit MF-319 /321, NaOH, TMAH,)			MF-			MF-
Exposure Time Duration (s)			20			20
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)			19			19 6
input power; CII:constant			CP			CP
Temperature (°C) Softbake Time Duration (s)			118			18 0
<b>Softbake: Hotplate</b>			5			5
Spin Speed #2 (rpm)			350			350
Promoter, Polyimide, Spin Speed #1 (rpm)			2 50			2 50
Hotnlate Temperature (°C) Resist, Primer / Adhesion Promotor Polyimide			S182 2			S182 2
Пту/Дећуагатоп раке:			20 0			0 0
Date	13/11/	13/11/25	13/11/08	13/11/	13/11/	13/11/
<b>Затр</b> је пате			TSoi- 14cN			TSoi- 15N

Comments	etches	At bridge #2; idem + Si etch (RIE) + SiO2 etch (BHF)	At bridge #3; idem + Strip (RIE + Wet + RIE)	Litho for Ni/TiN/Si bridge release with Si and SiO2 etches	At bridge #2; idem + Si etch (RIE) + SiO2 etch (BHF)	At bridge #3; idem + Strip (RIE + Wet +	Photomas k Cleaning.
Dektak measured step after Stripping (nm) Target only		691 6			291		
Final solvent rinse (IPA,); DI H2O rinse; N2 blow dry O2 Plasma Clean after wet strip		IPA ; RI DI; E dry	IPA ; RI DI; E N2 dry	IPA ; RI DI; E dry	IPA ; RI DI; E dry	IPA ; RI DI; E dry	IPA ; N2
Immersion or Soak Time (s)			1	1			.,
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes							
Immersion or Soak Time (s) Remover Clean #2 (Microposit		009	009	009	009	009	009
at 80°C for 130-180°C bakes		20 6	02	9 02	9 02	0 0 0 0	R 6
Remover Clean #1 (Microposit 1165,) Bath Temperature (°C) -1165		1165	1165	1165	1165	1165	Aceto
Initial Strip: Acetone rinse + IPA rinse before acetone dries + Blow dry (Yes/No)							
temperature treated PA) prior		RIE	RIE	RIE	RIE	RIE	
Etch of exposed target laver Dektak measured step after 22 frasina etal (frasina argu-		RIE + Wet	RIE + Wet	RIE + Wet	RIE + Wet	RIE + Wet	
Dektak measured step after Postbake (nm) Coating for Lift-off - Wet/Dry		258 R	261 R	8 V	260 R	259 R	
Postbake: Hotplate or Oven Temperature (°C) Short O2 Plasma De-scum (cleans thin resist left by dev.)				111 5			
Dektak measured step after development (nm)							
(s) amiT Aso2 no noisyammI				50			
Bath Temperature (°C) - For ME-319, 15-20°C is best				R			
Developer (Microposit MF-319 /321, U <sub>8</sub> OH, TMAH,)				MF- 319			
Exposure Time Duration (s)				20			
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)				19 6			
input power; CII:constant				CP			
Temperature (°C) Softbake Time Duration (s)				0 0			
Softbake: Hotplate				5 5			
Spin Speed #1 (rpm) Spin Speed #2 (rpm)	_			0 350			
Promoter, Polyimide,				22 50 0			
Hotnlate Temnerature (°C) Resist, Primer / Adhesion				20 S182 0 2			
ряка Пуурейудгайон раке:		3	5		3	5	
Date		13/11/	13/11/	oi- 13/11/ N 08	13/11/	13/11/	LS 2
Sample name				TSoi- 19N			MAS K-2

Comments	SOI Batch #4A. Litho for TIN etch on already patterned Si Bridges	At bridge #2; idem	At bridge #3; idem	SOI Batch #4A. Litho for TiN etch on already patterned Si Bridges	At bridge #2; idem	At bridge #3; idem	SOI Batch #4A. Litho for TiN etch on already patterned Si
Stripping (mn) Target only							
Dektak measured step after							
O2 Plasma Clean after wet strip	RI E	RI E	$\frac{RI}{E}$	RI E	RI E	RI E	RI E
DI H2O rinse; W2 blow dry	Bak	Bak e	Bak e	Bak	Bak e	Bak e	Bak
Final solvent rinse (IPA,);	Ä	Be	Be	Ä	Be	Be	, ä
Immersion or Soak Time (s)							
at 80°C for 130-180°C bakes							
Bath Temperature (°C) -1165							
Remover Clean #2 (Microposit 1165,)							
tisogonaiM) 54 ngol Jagyomag							
Immersion or Soak Time (s)	009	009	009	009	009	009	009
at 80°C for 130-180°C bakes	70	10	10	70	20	20	02
Bath Temperature (°C) -1165		7	7			7	
(, 2011	1165	1165	1165	1165	1165	1165	1165
Remover Clean #1 (Microposit	1	1	1	1.	1	1	1.
+ Blow dry (Yes/No)							
Initial Strip: Acetone rinse + APP Acetone rinse + APP APP APP APP APP APP APP APP APP A							
temperature treated PR) prior	Щ	E	E	RIE	RIE	E	RIE
ngitt (Allichi 1) that Shieh 1 40	RIE	RIE	RIE	R	RI	RIE	$\square$
Dektak measured step after Tech (nm) +Target							
Etch of exposed target layer	RIE	RIE		RIE	RIE		RIE
Coating for Lift-off - Wet/Dry	R	R		R	R		2
Dektak measured step after Postbake (nm)							
(cleans thin resist left by dev.)							
Temperature (°C) Short O2 Plasma De-scum							
Postbake: Hotplate or Oven	11 s			111 5			11 %
(mn) tnəmqoləvəb	130 1	130	130 5	130 1	130	130	130 1
Dektak measured step after		I.	I.	· ·	I.	I.	
Immersion or Soak Time (s)	50			50			50
Bath Temperature (°C) - For MF-319, 15-20°C is hest	A T			Z T			Z T
(, HAMT, HO <sub>B</sub> N, 125\	6			6			7.0
Developer (Microposit MF-319	MF-			MF- 319			MF-
Exposure Time Duration (s)	12.			112. 5			12.
(mW/cm2)							
intensity I-line=365nm; CI2: CP Power (W) or CI Intensity	19			19			119
input power; CII:constant intensity I-line=365mm; CI2:	C <sub>P</sub>			CP CP			CP CP
Softbake Time Duration (s)	0			118			118
(3°) syntanagmaT							
<b>Softbake: Hotplate</b>	11 &			11 8			11 5
Spin Speed #2 (rpm)	0 0			400 0			0 0
Spin Speed #1 (rpm)	0 0			0 0			0 0
Resist, Primer / Adhesion Promoter, Polyimide,	33			S181 3			33
Hotplate Temperature (°C)							
Dry/Dehydration bake:	20 0			20 0			20 0
Date	13/12/	12/	12/	13/12/	12/	12/	13/12/
v+°U	13/	13/12/	13/	13/	13/12/	13/12/	13/
	.1			.1 0			.1
Sample name	TSoi-			TSoi-			TSoi-
	L '	1			1	1	

Comments	Bridges	At bridge #2; idem. The only viable bridge #2 is broken, probably due to stiction forces with the handle during the wet strip	At bridge #3; idem	Photomas k Cleaning.	SOI Batch #4A. Litho for TiN etch on already patterned Si Bridges	At bridge #2; idem	At bridge #3; idem
Dektak measured step after Stripping (nm) Target only						, ,,,,	, ,,,
DI H2O rinse; N2 blow dry O2 Plasma Clean after wet strip		<u>М</u> п	k RI	2	k RI E	k RI E	k RI E
Final solvent rinse (IPA,);		Bak	Bak	IPA ; N2	Bak	Bak	Bak
at 80°C for 130-180°C bakes Immersion or Soak Time (s)							
Кетоуег Сlean #2 (Microposit 1165,) Ваth Temperature (°С) -1165							
Immersion or Soak Time (s)		009	009	009	009	009	009
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes		70	70	A T	20	70	70
Remover Clean #1 (Microposit 1165,)		1165	1165	Aceto	1165	1165	1165
Initial Strip: Acetone rinse + IPA rinse before acetone dries + Blow dry (Yes/No)							
temperature treated PA) prior		RIE	RIE		RIE	RIE	RIE
Etch of exposed target layer Dektak measured step after Litchinn) target layer		m			ம	ш	
Postbake (nm)  Coating for Lift-off - Wet/Dry		RIE			RIE	RIE	
(cleans thin resist left by dev.) Dektak measured step after Restholo (ram)							
Short O2 Plasma De-scum							
development (nm)  Dostbake: Hotplate or Oven		0	0		5 5	0	0
Dektak measured step after		130 8	130		130 1	130 8	130
MF-319, 15-20°C is hest Immersion or Soak Time (s)					20		
Bath Temperature (°C) - For					~ ⊢		
Developer (Microposit MF-319 (, MAMT, HO <sub>8</sub> U, 125)					MF-		
Exposure Time Duration (s)					12.		
intensity I-line=365nm; CI2; CP Power (W) or CI Intensity (mW/cm2)					19		
input power; CII:constant					CP		
Temperature (°C) Softbake Time Duration (s)					18		
Softbake: Hotplate					111		
Spin Speed #2 (rpm)					400		
Spin Speed #1 (rpm)					0 0		
Resist, Primer / Adhesion Promoter, Polyimide,					S181 3		
Dry/Dehydration bake:					20 0		
Date		13/12/ 03	13/12/		13/12/	13/12/ 03	13/12/
Затріс пате				MAS K-2	TSoi- 12b		

Comments	SOI Batch #4A. Litho for TiN etch on already patterned Si Bridges	At bridge #2; idem	At bridge #3; idem	Microwa ve plasma strip: 6 20min each. No effect observed. 1165 strip has no effect. Scrubbin g in acctone leads to the collapse of the 2 viable bridges #1 and #2. End
Dektak measured step after Stripping (nm) Target only				
O2 Plasma Clean after wet strip	RI	RI E	RI E	
Final solvent rinse (IPA,); UN H2O rinse; N2 blow dry	Bak e	Bak e	Bak	PA DI; dyy; e
Immersion or Soak Time (s)				0 0
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes				<b>≃</b> ⊢
Remover Clean #2 (Microposit 1165,)				Aceto
(s) smiT AsoS vo noisvammI	009	009	009	009
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	70	70	70	0.2
Remover Clean #1 (Microposit 1165,)	1165	1165	1165	1165
Initial Strip: Acetone rinse + IPA rinse before acetone dries + Blow dry (Yes/No)				
temperature treated PR) prior	RIE	RIE	RIE	-6x
Dektak measured step after <u>Prich (nm) ten (restana) sk</u>				
Coating for Lift-off - Wet/Dry Etch of exposed target layer	RIE	RIE		
Postbake (nm)				
(cleans thin resist left by dev.)  Dektak measured step after				
Temperature (°C) Short O2 Plasma De-scum	11 c			1
development (nm) Postbake: Hotplate or Oven	130 I	130 8	130 5	
Immersion or Soak Time (s) Dektak measured step after	7	I	I	
ME-319, 15-20°C is hest	≃ ⊢			
Developer (Microposit MF-319 /321, NaOH, TMAH,) Bath Temperature (°C) - For	F-			
Exposure Time Duration (s)	12.			
(mW/cm2)	6 6			
input power; CII:constant intensity I-line=365nm; CI2: CP Power (W) or CI Intensity	Ĉ			
Softbake Time Duration (s)	0			
Softbake : Hotplate Temnerature (°C)	11 8			
(mqr) 2# bəəq8 niq8	400			
Spin Speed #1 (rpm)	0 0			
Resist, Primer / Adhesion Promoter, Polyimide,	S181 3			
Dry/Dehydration bake: Hotnlate Temnerature (°C)	20 0			
Date	13/12/	13/12/	13/12/	13/12/
Sample name	TSoi- 18			TSoi-

Comments	of sample? CNT growth serforme 1 anyway eads to Aligned CNT on he he Bridge
	of san CN gro per d an lead Ali CN the bro Bri Bri Bri #31
Dektak measured step after Stripping (nm) Target only	
O2 Plasma Clean after wet strip	
DI H2O rinse; N2 blow dry	
Final solvent rinse (IPA,);	
(s) əmiT AsoS 10 nois19mml	
Bath Temperature (°C) -1165 at 80°C for 130-180°C bakes	
Remover Clean #2 (Microposit 1165,)	
Immersion or Soak Time (s)	
at 80°C for 130-180°C bakes	
Bath Temperature (°C) - 1165	
Remover Clean #1 (Microposit)	
+ Blow dry (Yes/No)	
+ serins Acetone rinse + Strip: Acetone rinse + All Arinse before acetone dries	
temperature treated PR) prior	
Mask (mm) + Target - Mask 1 40	
Etch of exposed target layer Dektak measured step after	
Coating for Lift-off - Wet/Dry	
Postbake (nm)	
(cleans thin resist left by dev.) Dektak measured step after	
Temperature (°C) Short O2 Plasma De-scum	
Postbake: Hotplate or Oven	
(mn) tnəmqoləvəb	
Dektak measured step after	
ME-319, 15-20°C is hest Immersion or Soak Time (s)	
Total - (0°) syntangemeT dira	
Developer (Microposit MK-319 /321, NaOH, TMAH,)	
Exposure Time Duration (s)	
(Zm2/Wm)	
intensity I-line=365nm; CI2: CP Power (W) or CI Intensity	
input power; CII:constant	
Softbake Time Duration (s)	
Бойолке : погріже Тетрегатиче (°С)	
Spin Speed #2 (rpm) Softbake: Hotplate	
Spin Speed #1 (rpm)	
Promoter, Polyimide,	
Hotplate Temperature (°C) Resist, Primer / Adhesion	
Dry/Dehydration bake:	
Эзге	
<b>Затр</b> је пате	

Plasmionique Inc.

Annex 1E: Wet etching/cleaning processes

etch (nm) +Target-Mask Comments	3415 Step measured after Si etch	Visual inspection					idem; Handle Si visible and clean in the trenches around all bridges.				Witness Bridges #3 released					
etch (nm) +Target-Mask Dektak measured step #3 post-																
etch (nm) +Target-Mask Dektak measured step #2 post-																
Dektak measured step #1 post-	3170															
Post-Etch Bake Time Duration		9   9	9   9	9   9	9   9	9 9	9 9	9 60	9 60	9   9	5 120	9 9	9 9	9 9	9   9	9 8
DI H2O Rinse (DI): 2min; Nitrogen blow dry (N2) Post-Etch Bake Temperature	DI; N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2	DI; 115 N2
Etch/Clean Time Duration (s)	0	300	300	009	009	009	009	009	009	300	300	300	300	300	300	300
Agitation: Stirring Speed (rpm) - (mgr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
(O°) Mixture Temperature	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1:#2:#3	6:1	6:1	6:1	6:1	6:1	6:1	6:1	6:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF	HIF	HF	HF	HF	HF	HIF	HF	HF	HF	HF	HIF	HF	HF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
Wet Etchant/Cleaning Mixture usual name	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Target layer material to etch or clean	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	0	1	2	3	4	v	9	7	8	6	10	11	12	13	14	15
Date	13/11/18											13/11/19				
Sample or Recipe name	TSoi- 13bN															

гзпэттоЭ						Witness Bridges #1 released			Witness Bridges #2 released - End of etch? To be confirmed with dektak measurements across the bridges							Step measured after Si etch	Visual inspection	
Dektak measured step #3 post- etch (nm) +Target-Mask									318						180	2057		
Dektak measured step #2 post- etch (nm) +Target-Mask									482		434				346	4496		
Dektak measured step #1 post- etch (nm) +Target-Mask									458		372				346	6099		
Post-Etch Bake Time Duration (s)	0	09	09	09	120	120	09	120	120	120	120	120	120	120	120		09	09
Post-Etch Bake Temperature (°C) - re-increase adhesion	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115		115	115
DI H2O Rinse (DI): 2min; Nitrogen blow dry (N2)	NZ JI	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2
Etch/Clean Time Duration (s)	300	300	300	360	420	420	300	360	300	330	330	330	330	340	340	0	300	300
Agitation : Stirring Speed IsunsM rot M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
(O°) Mixture Temperature	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1.#2.#3	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	6:1	6:1	6:1
Wet Mixture Component #2	HF	HIF	HF	HF	HF	HIF	HF	HF	HF	HF	HF	HF	HF	HIF	HF	HIF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
orutziM gningal/Cleaning Mixture oman lausu	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Тагдеt layer material to etch or clean	25	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	0	1	2
Date							13/11/20			13/11/22						13/11/18		
Sample or Recipe name																TSoi- 14bN		

гзпэттоЭ		Bridge #3 washed out. Normal since there was no Si underneath		Handle Si visible and clean in the trenches around all bridges.										Witness Bridges #2 released				
Dektak measured step #3 post- etch (nm) +Target-Mask																		
Dektak measured step #2 post- etch (nm) +Target-Mask																		
Dektak measured step #1 post- etch (nm) +Target-Mask																		
Post-Etch Bake Time Duration (s)	09	09	09	09	09	09	09	120	09	09	09	09	09	120	09	09	09	120
Post-Etch Bake Temperature (O°)	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
; nim2 :(IU) sinse O2H IU Nitrogen blow dry (N2)	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2
Etch/Clean Time Duration (s)	009	009	009	009	009	540	300	300	300	300	300	300	300	009	300	300	360	420
Appending Speed Stirring Speed IsunsM rof M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
(O°) Mixture Temperature	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1.#2.#3	6:1	6:1	6:1	6:1	6:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF	HF	HF	HIF	HF	HF	HF	HF	HF	HF	HE	HF	HF	HF	HF	HF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
Wet Etchant/Cleaning Mixture	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Target layer material to etch or clean	22	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	3	4	w	9	7	80	6	10	11	12	13	14	15	16	17	18	19	20
Date									13/11/19									
Sample or Recipe name																		

Соттептя	Witness Bridges #1 and #2 released - End of etch? To be confirmed with dektak measurements across the bridges								Step measured after Si etch	Visual inspection		Dektak measurements across the bridges deteriorate the edges of the PR protecting them. Perform measurements only when required	Handle Si visible and clean in the trenches around all bridges.				
Dektak measured step #3 post- etch (nm) +Target-Mask	NA							NA	4432								
Dektak measured step #2 post- etch (nm) +Target-Mask	19							26	4592								
Dektak measured step #1 post- etch (nm) +Target-Mask	445		382				381	348	4380								
Post-Etch Bake Time Duration (s)	120	120	120	120	120	120	120	120		09	09	120	120	120	120	120	120
Post-Etch Bake Temperature  O(\(^\infty\) - re-increase adhesion	115	115	115	115	115	115	115	115		115	115	115	115	115	115	115	115
DI H2O Rinse (DI): 2min ; Nitrogen blow dry (N2)	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI;	DI; N2	DI; N2	DI;	DI; N2	DI; N2	DI; N2	DI;
Etch/Clean Time Duration (s)	420	330	330	330	330	340	340	360	0	300	009	480	480	300	360	360	300
Agitation : Stirring Speed Invited Speed S	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
#1:#2:#3 Mixture Temperature (°C)	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	6:1	6:1	6:1	6:1	6:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
Wet Etchant/Cleaning Mixture	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Тагget layer material to etch or clean	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	21	22	23	24	25	26	27	28	0	1	2	ю	4	3	9	7	<b>∞</b>
Date		13/11/22							13/11/20								
Sample or Recipe name									TSoi- 14cN	_							

sзиэшшоЭ														Witness Bridges #3 released	Witness Bridges #1 and #2 released - End of etch? To be confirmed with dektak measurements across the bridges			
Dektak measured step #3 post- etch (nm) +Тагget-Маsk															513			
Dektak measured step #2 post- etch (nm) +Target-Mask																		
Dektak measured step #1 post- etch (nm) +Target-Mask															499			
Post-Etch Bake Time Duration (s)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Post-Etch Bake Temperature (°C) - re-increase adhesion	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
DI H2O Rinse (DI): 2min; Witrogen blow dry (N2)	DI; N2		DI; N2		DI; N2		DI; N2	DI; N2	DI; N2		DI; N2		DI; N2	DI; N2	DI; N2		DI; N2	DI; N2
Etch/Clean Time Duration (s)	300	300	300	300	300	300	330	330	330	330	330	360	360	360	360	360	360	360
Agitation : Stirring Speed leuneM rof M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
(O°) Mixture Temperature (°C)	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1:#2:#3	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HIF	HF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
97utxiM gninsəlOtənatdətə Wixture əmsn İsusu	BOE, BHF		BOE, BHF		BOE, BHF		BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF		BOE, BHF						
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Target layer material to etch or clean	25	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Date						13/11/21										13/11/22		
Sample or Recipe name																		

Comments								Step measured after Si etch	Visual inspection. No Bridge #3 (sample broken previously)		Dektak measurements across the bridges deteriorate the edges of the PR protecting them. Perform measurements only when required					Handle Si visible and clean in the trenches around all bridges.	
Dektak measured step #3 post- etch (nm) +Target-Mask							55	5997									
Dektak measured step #2 post- etch (nm) +Target-Mask							320	2689									
Dektak measured step #1 post- etch (nm) +Target-Mask							302	3647									
(s)	120	120	120	120	120	120	120	<u>(C)</u>	09	120	120	120	120	120	120	120	120
Post-Etch Bake Temperature (°C) - re-increase adhesion Post-Etch Bake Time Duration	115	115	115	115	115	115	115		115	115	115	115	115	115	115	115	115
DI H2O Rinse (DI): 2min; Witrogen blow dry (N2)	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2
Etch/Clean Time Duration (s)	360	360	370	370	420	480	200	0	300	009	480	480	480	480	480	480	300
Agitation : Stirring Speed lennsM rof M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
(O°) Mixture Temperature (°C)	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1:#2:#3	3:1	3:1	3:1	3:1	3:1	3:1	3:1	6:1	6:1	6:1	6:1	6:1	6:1	6:1	6:1	6:1	3:1
Wet Mixture Component #2	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
Wet Etchant/Cleaning Mixture	BOE, BHF		BOE, BHF	BOE, BHF	BOE, BHF		BOE, BHF	BOE, BHF		BOE, BHF	BOE, BHF		BOE, BHF				BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Тагget layer material to etch or clean	25	SiO2	SiO2 S	SiO2 S	SiO2 S	SiO2 S	SiO2 S	SiO2 S	SiO2 S	SiO2	SiO2 s	SiO2	SiO2 S	SiO2 S	SiO2 S	SiO2 S	SiO2 S
Etch/Clean Step/iteration #	27 5	28 2	29 8	30 8	31 8	32 8	33 8	0	1	2	8	4	vo	9	7	<b>%</b>	6
Date								13/11/20									
Sample or Recipe name								TSoi- 15N									

Соттепія		PR starts peeling off at TiN electrodes borders!								Witness Bridges #1 released								
Dektak measured step #3 post- etch (nm) +Target-Mask																		
Dektak measured step #2 post- etch (nm) +Target-Mask																		
Dektak measured step #1 post- etch (nm) +Target-Mask																		
Post-Etch Bake Time Duration (s)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Post-Etch Bake Temperature (°C) - re-increase adhesion	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
; nim2 :(IU) seniA O2H IU (M2) Yib wold negoviyiV	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2
Etch/Clean Time Duration (s)	360	360	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Agitation : Stirring Speed IsuasM or M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
#1:#2:#3 Mixture Temperature (°C)	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF.	HF	F HIF	HF	F HF	HF	F HF	HF	HF	HF	HF	HF						
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
Wet Etchant/Cleaning Mixture oman lausu	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Target layer material to etch or clean	25	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Date									13/11/21									
Sample or Recipe name				_	_	_	_	_						_	_	_		

гзиэттоЭ		Witness Bridges #3 released		Witness Bridges #2 released - End of etch? To be confirmed with dektak measurements across the bridges										Step measured after Si etch	Visual inspection			
Dektak measured step #3 post- etch (nm) +Target-Mask				394									220	3170				
Dektak measured step #2 post- etch (nm) +Target-Mask				453									209	3693				
Dektak measured step #1 post- etch (nm) +Target-Mask				352									214	2492				
Post-Etch Bake Time Duration (s)	120	120	120	120	120	120	120	120	120	120	120	120	120		09	09	120	120
Post-Etch Bake Temperature (°C) - re-increase adhesion	115	115	115	115	115	115	115	115	115	115	115	115	115		115	115	115	115
DI H2O Rinse (DI): 2min; Nitrogen blow dry (N2)	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2
Etch/Clean Time Duration (s)	330	330	330	330	330	330	330	330	330	330	330	330	360	0	300	009	480	480
Agitation : Stirring Speed IsunaM rot M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Mixture Temperature (°C)	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1.#2.#3	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	6:1	6:1	6:1	6:1	6:1
Wet Mixture Component #2	HIF	HIF	HIF	HF	HF	HIF	HF	HF	HIF	HIF	HF	HF	HIF	HIF	HF	HIF	HF	HF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
orutxiM gninsol/Cleaning Wixture omsn Isusu	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
Тагget layer material to etch or clean	25	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	28	29	30	31	32	33	34	35	36	37	38	39	40	0	1	2	8	4
Date					13/11/22									13/11/20				
Sample or Recipe name														TSoi- 19N				

Соттептя		Handle Si visible and clean in the trenches around all bridges.			Witness Bridges #1 released but its TiN seems deteriorated													
Dektak measured step #3 post- etch (nm) +Target-Mask																		
Dektak measured step #2 post- etch (nm) +Target-Mask																		
Dektak measured step #1 post- etch (nm) +Target-Mask																		
Post-Etch Bake Time Duration (s)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Post-Etch Bake Temperature (°C) - re-increase adhesion	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
DI H2O Rinse (DI): 2min; Nitrogen blow dry (N2)	DI;	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2
Etch/Clean Time Duration (s)	480	480	300	360	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Agitation : Stirring Speed IsunsM rot M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
(O°) Mixture Temperature	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Wet Mixture Component ratio #1.#2:#3	6:1	6:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF	HIF	HIF	HF	HF	HIF	HF	HIF	HIF	HIF	HF	HF	HF	HF	HIF	HIF	HF	HIF
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F
Wet Etchant/Cleaning Mixture oman lausu	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822
тагдеt layer material to etch or clean	22	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2
Etch/Clean Step/iteration #	S.	9	7	∞	6	10	11	12	13	14	15	16	17	18	19	20	21	22
Date												13/11/21						
Sample or Recipe name																		

Соттепія										Witness Bridges #2 released - End of etch? To be confirmed with dektak measurements across the bridges								
Dektak measured step #3 post- etch (nm) +Target-Mask																		
Dektak measured step #2 post- etch (nm) +Target-Mask										409								
Dektak measured step #1 post- etch (nm) +Target-Mask																		
Post-Etch Bake Time Duration (s)	00	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Post-Etch Bake Temperature (O°)	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
DI H2O Rinse (DI): 2min; Nitrogen blow dry (N2)	DI;	DI;	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2	DI; N2							
Etch/Clean Time Duration (s)	300	300	330	330	330	360	360	360	360	360	360	360	360	360	360	370	390	420
Agitation : Stirring Speed IsunsM rot M - (mqr)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
#1:#2:#3 Mixture Temperature (°C)	RT	RT	RT	RT	RT	RT	RT	RT	RT									
Wet Mixture Component ratio	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Wet Mixture Component #2	HF	HIF	HF	HF	HF	HF	HIF	HF	HF									
Wet Mixture Component #1	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F	NH4F									
Wet Etchant/Cleaning Mixture usual name	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF	BOE, BHF									
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822	S1822									
Тагget layer material to etch or clean	25	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2	SiO2								
Etch/Clean Step/iteration #	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Date											13/11/22							
Sample or Recipe name																		

Соттепія		
Dektak measured step #3 post- etch (nm) +Target-Mask		NA
Dektak measured step #2 post- etch (nm) +Target-Mask		225
Dektak measured step #1 post- etch (nm) +Target-Mask		NA
Post-Etch Bake Time Duration (s)	120	120
Post-Etch Bake Temperature (O°) - re-increase adhesion	115	115
DI H2O Rinse (DI): 2min ; Nitrogen blow dry (N2)	DI; N2	DI; N2
Etch/Clean Time Duration (s)	480	480
Agitation : Stirring Speed IsunaM rot M - (mqr)	200	200
Mixture Temperature (°C)	RT	RT
Wet Mixture Component ratio	3:1	3:1
Wet Mixture Component #2	HF	HF
Wet Mixture Component #1	NH4F	NH4F
Wet Etchant/Cleaning Mixture nsual name	BOE, BHF	BOE, BHF
Masking layer material for etch: Resist, metal, oxide,	S1822	S1822
Тагget layer material to etch or clean	SiO2	SiO2 S1822
Etch/Clean Step/iteration #	41	42
Date		
Sample or Recipe name		

Plasmionique Inc.

Annex 1E: Plasma etching/cleaning with Tegal T901e RIE system

	f		f 0	f d	f o
Comments	Tests prior to Plasma Clean of TSoi-	idem	Plasma Clean of TSoi- 13bN after 1st bad litho for Ni lift-off	Plasma Clean of TSoi- 13bN after 2nd bad litho for Ni lift-off	Plasma Clean of TSoi- 13bN after 3rd bad litho for Ni lift-off
#3 (nm) +Target -Mask	Te Pr	jpi	CI TS 13 aff for ba for lift f	CI TS aff	CC TS PE
Dektak measured height at step					
Dektak measured height at step #2 (nm) +Target -Mask					
#1 (nm) +Target -Mask					
Dektak measured height at step	0	,		,	,
Vent Time (s)  Etch iteration #		0 1		1	0 1
sc rot CV		20	50	20	50
Pressure (mTorr) 0-5k		3	3	3	3
Purge Pumpdown threshold		50	50	50	50
Cell B (µA) - Current level of Photocell B (0.0032-1)	0.00	0.00	32	0.00	32
(1-2£00.0) A Iləəotord	0.00	0.00	0.00	0.00	32
Ignored Plasma Int. changes Cell A (µA) - Current level of					
Limiting (None, Low, High) -	No	No	No	No	No
Yenresents Plasma Infensity Normalize (s) - Lime 1-60k to The state of	10	10	10	10	10
Normalize (UIV) - Level 0-10 Trepresents Plasma Intensity	5	5	S	S	v
.01, 6.7, 6, 6.8, 3, 6.1, 1) mbd	1	-	-	-	-
A/B; Bias DC+, DC-)	B/ A	B/ A	B/ A	B/ A	B/
Timer (s)	30	300	120	120	120 0
He flow (seem) - MFC#4					
SF6 flow (seem) - MFC#3					
MFC#1 O2 adjusted flow (seem) - Suseem C2F6 - MFC#2	31.	31.	31.	31.	31.
Throngh metering valve - (HF3 = Freench 1000 (seem) -					
Clean Channel (on, off) - U2 Through metering valve	JO f	Of f	of f	JO f	Of f
Lower Electrode Temperature		17	19	18	17
during efth (DIV) max Upper Electrode 1 emperature		17	19	18	18
Fudboint measured level		9.	9	3.2	%
DC Self-Bias Voltage (V)		3.	- 10 2	3.	- 94
Keflected RF Power (W) -		53	52	52	53
avg, RF Power (W)	0	50	50	50	50
fwd. CW RF Power (W)	0	9	50	50	50
MKS Baratron 127A (mTorr) Measured Working Pressure -	26 6	26 6	22 5	22 5	22 5
Raratron 1274 (mTorr) Working Pressure Setpoint -	22 5	22 5	22 5	22 5	22 5
Zensorend: D.Plasma-Timer:  - Zansorend: D.Plasma-Timer:  - Canadam - Tressure - M.K Tressure - M.K Tressure - Tres	50				
B:Pumpdown; C:Plasma- SensorEnd: D:Plasma-Timer:	B, D,	D, F,	Ų Ą Ħ	D, F,	D,
Recipe Number	14				
Masking layer material - Resist, metal,	non				
Targeted layer for etching	Si				
	/0				
Date	13/10/				
Sample or Recipe name	Si- substr ate		TSoi- 13bN	TSoi- 13bN	TSoi- 13bN

Comments	Tests prior to Plasma Clean of TSoi-	idem	Plasma Clean of TSoi- 13bN after 4th bad litho for Ni lift-off	Tests prior to Plasma Clean of TSoi-	idem	Plasma descum prior to Ni coating	Plasma descum prior to Ni coating
#3 (nm) +Target -Mask	T PP	pi Di	CC T. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	T PP C C T T T T T T T T T T T T T T T T	id	A B Z S	A B AZ S
Dektak measured height at step							
#2 (nm) +Target -Mask							
#1 (nm) +Target -Mask Dektak measured height at step							
Dektak measured height at step							
Etch iteration #	0	1	1	0	1	1	1
(e) smiT JnoV		20	20		20	20	20
rumber of Purges (1-9) - with		3	3		3	3	3
Purge Pumpdown threshold Pressure (mTorr) 0-5k Number of Purges (1-9) - with		50	50		50	50	50
Photocell B (0.0032-1)	0 2	0.2	200	0 2	2	2 2	0.0
Tell B (µA) - Current level of	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cell A (µA) - Current level of Photocell A (0.0032-1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ignored Plasma Int. changes	No	No ne	No ne	No	No ne	No ne	No ne
normalize Plasma Intensity - Low, High) -							
represents Plasma Intensity 100-1 ime 1-60k to 100-1 ime 1-60k to	10	10	10	10	10	10	10
Normalize (UIV) - Level 0-10	S	5	5	5	5	5	S
.01 ,C.7 ,C ,C.5 ,Z ,C.1 ,1) mrd	-1	-	1	1	1	1	1
A/B; Bias DC+, DC-)	B/	B/	B/	B/	B/A	B/ A	B/
Timer (s)	30	300	120 0	30	120 0	30	30
He flow (seem) - MFC#4							
SF6 flow (seem) - MFC#3							
50sccm C2F6 - MFC#2	31.	31.	31.	31.	31.	31.	31.
OZ adjusted flow (secm) -	(1)	6.1	(1)	(4)	(1)	(1)	(4)
through metering valve (Secm) -	÷,	¥.	of	Of f	J.	Ŧ,	£ ,
Ooy (To (00) our Clean Channel (0n, 011) - U2	Of f	of f		O	Of f	JO (	Of t
Lower Electrode Temperature		18	19		16	19	18
during etch (DIV) max Upper Electrode Lemperature		18	20		17	20	18
Endpoint measured level		1.	1. 4		2.	1.	1.
DC Self-Bias Voltage (V)		- 10 9	- 10 9		- 10 6	. %. ∞	3.
Keilected KF Power (W) - ACG-10		54	48		50	48	48
avg. RF Power (W)	0	50	50	0	50	50	50
fwd, CW RF Power (W)	0	50	20	0	50	50	50
MKS Baratron 127A (mTorr)		4 4	5 5		8 6	22 27	5 5
MKS Baratron 1274 (mTorr) Measured Working Pressure -	2			2			
Raratron 127A (mTorr) Working Pressure Setpoint -	22 5	22 5	5 5	22 5	22 5	22 5	22 5
Pumpdown Pressure - MKS -	50			50			
B:Pumpdown; C:Plasma-	B, D,	D, F,	D, E,	B, D,	D, E,	E, E, D	E, E,
Recipe Number	14			14		14	14
Masking layer material - Resist, metal,	non			non		ma- N 141	ma- N 141 0
Targeted layer for etching	Si			Si		ma- N 141 0	ma- N 141 0
Date	13/11/			13/11/			
Sample or Recipe name	Si- substr ate		TSoi- 13bN	Si- substr ate		TSoi- 13bN	TSoi- 14bN

Comments	Plasma descum prior to Ni coating	Plasma descum prior to Ni coating	Plasma descum prior to Ni coating	Tests prior to Plasma Strip of Sample batch 3B	idem	Plasma Strip after 1st Wet Strips	Plasma Strip after 1st Wet Strips	Plasma Strip after 1st Wet Strips
#3 (nm) +Target -Mask								
#2 (nm) +Target -Mask Dektak measured height at step								
Dektak measured height at step								
Dektak measured height at step #I (nm) +Target -Mask								
Etch iteration #	1	1	1	0	1	1	1	1
Vent Time (s)	20	20	20		20	20	20	50
SC 101 CV	3	3	3		3	3	3	6
Number of Purges (1-9) - with	50	50	50		50	50	50	50
Photocell B (0.0032-1) Purge Pumpdown threshold				9 4				
Cell B (µA) - Current level of	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cell A (µA) - Current level of Photocell A (0.0032-1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ignored Plasma Int. changes	No ne	No ne	No ne	No	No ne	No	No	No
normalize Plasma Intensity Limiting (None, Low, High) -	10 N	10 N	10 1	10 N	$10 \begin{vmatrix} 1 \\ 1 \end{vmatrix}$	10 1	10 1	10 1
vanresents Plasma Intensity 100 - I ami I - (s) szilamion								
15) of the Input Normalize (UIV) - Level 0-10	5	ς.	5	5	5	5	5	
.01 .6.1 .6 .6.5 .5 .6.1 .1) misə	1		1	1	1	1	1	
A/B; Bias DC+, DC-)	B/	B/	B/	B/	B/ A	B/	B/	A B
Timer (s)	30	30	30	30	009	180	180	180
He flow (seem) - MFC#4								
SF6 flow (seem) - MFC#3								
Oz adjusted flow (seem) -	31.	31.	31.	31.	31.	31.	31.	31.
OZ adjusted flow (scem) -								
CHE'S = Freena's flow (seem) -	of f	Of f	Of f	Of	of f	of f	Of f	of f
Clean Channel (on, off) - UZ	18	19	19		18	18	18	18
Lower Electrode Temperature	18	18	18		18	18	18	18
Upper Electrode Temperature	3.	3	3.		1.	1. 4	1.	1. 4
DC Self-Bias Voltage (V)	3.	- 10 6	- 10 6		. %	- 12 5	- 12 5	- 12
01-53V	48	48 11	48 11		52 3	53 1	53 1	53 1
avg, RF Power (W) Reflected RF Power (W)				0				
	0 50	0 50	0 50		0   50	0 50	0 50	0 50
MKS Baratron 127A (mTorr) fwd, CW RF Power (W)	2 50	20	50	0	50	50	50	50
MKS Baratron 1274 (mTorr) Measured Working Pressure	22 5	22 5	22 5		22 5	22 5	22 5	5
Working Pressure Setpoint -	22 5	22 5	22 5	22 5	22 5	22 5	22 5	5
SensorEnd: D'Plasma-Timer: Fumpdown Pressure - MKS -				50				
B:Pumpdown; C:Plasma-	D,	ъ, E, D	E, D	B, D,	D, E,	D, E,	D, E,	Ú H H
Recipe Number	14	14	14	14		14	14	14
Masking layer material - Resist, metal,	ma- N 141	ma- N 141	ma- N 141	non		ma- N 141 0	ma- N 141 0	ma- N 141
Targeted layer for etching	ma- N 141 0	ma- N 141	ma- N 141	Si		ma- N 141 0	ma- N 141 0	ma- N 141
Date				13/11/				
Sample or Recipe name	TSoi- 14cN	TSoi- 15N	TSoi- 19bN	Si- substr ate		TSoi- 13bN	TSoi- 14bN	TSoi- 14cN

Dektak measured height at step  #3 (nm) +Target -Mask  Brips Agrip aft  Strip		
### Target - Mask and target - Mask and target - Mask and target - Mask at step		
		$\vdash$
Dektak measured height at step		
Dektak measured height at step #I (nm) +Target -Mask		
O O O D Etch iteration #	1	2
S S S S Nent Time (s)	20	20
8C 101 CV	.,	8
12-J) (1-7)	50	50
blodseadt amobamil apaul		
80.0 80.0 80.0 80.0 80.0 80.0 80.0 80.0	0.00	0.00
30 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	0.00	0.00
S S S S S S S S S S S S S S S S S S S	Lo	w w
AINDIAN KINKLA AMKILANI		
Tight a market of the state of	20	20
130 of the Input (VIII) - Level 0-10	3	3
.01 ,C. ,C.C.C. ,L. ,C.I. ,1) misD	-1	-
> m     > m     > m     > m     > m     VB; Bigs DC+, DC-)	B/ A	B/ A
3 0 8 0 8 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	300	300
○ ○	10	10
≥ SF6 flow (secon) - MFC#3	12	12
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		
THE	7	7
- (Ho (10) Infinite Install 1	of f	JO f
(1) - (Ho no) baned ace)		
Lower Electrode Temperature	17	3 19
Service City Control of Control o	18	18
Endpoint measured level	3.	3.
Sold Self-Bias Voltage (V)	- 20 4	- 14 9
$\mathcal{Z}$	15	15
o S S S S S S S o	15	15
o & & & & & & & & & & & & & & & & & & &	15	15
~ 2 ~ 2 ~ 2 ~ 2 ~ 2 ~ 2 ~ 2 ~ 2 ~ 2 ~ 2	40	40
- 40 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	40	40
triorite entrangement		
- SAM - ourserd anothernis	E, E,	Q F, F
Recipe Number B:Parameter A:		
··· (IDANII (ISISAN		$\vdash$
- Isi natering layer material - isi naterial - isi		
S         Targeted layer for etching		
Date 13/11/ 06 13/11/ 13/11/		
Затре от Весіре пате         Порітивни пате		

Comments	Dektak measure ment prior to Si etch			Dektak measure ment prior to Si etch				Dektak measure ment prior to Si etch		
#3 (nm) +Target -Mask	20	387	341	271		228	205	262		454
#2 (nm) +Target -Mask Dektak measured height at step	69	356 3	378 3	283 2		478 2 9	449 2	3		479 479 1
#1 (nm) +Target -Mask Dektak measured height at step			_							
Dektak measured height at step	259	363	317	33		587 2	995	257		457
Etch iteration #	0	1	2	0	1	2	က	0	1	2
Serof CV (s) Smi Tana V		20	20		20	20	20		20	20
Pressure (mTorr) (1-5k Number of Purges (1-9) - with		3	33		3	3	3		3	3
Purge Pumpdown threshold		50	50		50	50	50		50	50
Cell B (µA) - Current level of Photocell B (0.0032-1)	0.00	0.00	0.00	0.00	0.00 32	0.00 32	0.00	0.00	0.00 32	0.00
(1-2£00.0) A Iləsətədi A										
Cell A (µA) - Current level of	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limiting (None, Low, High) - Ignored Plasma Int. changes	No	Lo	Lo	No	Lo	Lo	Lo	No	Lo	Lo
vtienatul emeel asilemaan	10	20	20	10	20	20	20	10	20	20
represents Plasma Intensity Normalize (s) - Lime 1-60K to	3	3	3	3	3	3	33	3	3	3
Gam (1, 1.5, 2, 5.5, 5, 7.5, 10, 15) of the Input Normalize (11V) - Level 0-10	1	1	1	1	1	1	1	1	1	1
A/B; Bias DC+, DC-)	B/ A	B/ A	B/ A	B/ A	B/ A	B/ A	B/ A	B/ A	B/ A	B/ A
Timer (s)	30	240	240	30	240	240	180	30	240	240
He flow (seem) - MFC#4	10	10	10	10	10	10	10	10	10	10
SF6 flow (seem) - MFC#3	12	12	12	12	12	12	12	12	12	12
50sccm C2F6 - MFC#2										
OZ adjusted flow (seem) - OT adjusted flow (seem) -	7	7	7	7	7	7	7	7	7	7
Clean Channel (on, on) - O2  through metering valve  CHF3 = Freent3 flow (seem) -	Of f	Of f	JO f	Of f	Of f	JO f	Of f	Of f	JO f	Of f
Lower Electrode Temperature (°C) (lean Channel (on, off) - UZ		19	19		19	17	18		19	17
(50)		19	19		19	18	18		19	18
Endpoint measured level Upper Electrode Lemperature		3.	3.		3.	3.	3.		3.	3.
DC Self-Bias Voltage (V)		3.	۰ ۳. ∞		3.	3.	- 19 5		3.	3.
Keflected KF Power (W) -		8	15		8 8	15	9 6		8 8	15
avg. RF Power (W)	0	15	15	0	15	15	15	0	15	15
fwd. CW RF Power (W)	0	15	15	0	15	15	15	0	15	15
MKS Baratron 127A (mTorr)		40 0	40		40 0	40	40		40 0	40
Working Pressure Serpoint - MKS Baratron 127A (mTorr)	40	40	40	40	40	40	40	40	40 0	40
Raratron 127A (m.Torr) Working Pressure Setpoint	50			50				50		
B:Pumpdown; C:Plasma- SensorEnd: D:Plasma-Timer: Fumpdown Pressure - MKS -	B,	D, E,	D, F,	B,	D, E, F	D, E, F	D, E,	B, D	D, E, F	D, E,
Recipe Number	13			13				13		
Masking layer material - Resist, metal,	S18 22			S18 22				S18 22		
Targeted layer for etching	Si			Si				Si		
Date	13/11/			13/11/				13/11/		
Sample or Recipe name	TSoi- 13bN			TSoi- 14bN				TSoi- 14cN		

		k ire o h						k ire o			9.0
samme)		Dektak measure ment prior to Si etch						Dektak measure ment prior to Si etch			Tests prior to Plasma
Dektak measured height at step #3 (mm) +Target -Mask	443	261			607	623	599 7	259	363	317	
#2 (nm) +Target -Mask	459 2	258			607	9 002	689	260	385	369	
#1 (nm) +Target -Mask Dektak measured height at step	438 4	5 258 2			399 6	362 7	364 6	8 8	253 3	249 3	
Etch iteration # Dektak measured height at step	4	0 2	1	2	3	4 3	3	0	1 2	2	0
Vent Time (s)	70		20	70	70	70	20		70	70	
MIN - (C-1) eagin 1 to 130min/	8		3	ε.	ε,	ε.	m		ε,	ω.	
Purge Pumpdown threshold Pressure (mTorr) 0-5k Number of Purges (1-9) - with	50		50	50	50	50	50		50	50	
(1-2£00.0) B (1-2£0)	0.00 32	0.00	0.00 32	0.00 32	0.00 32	0.00 32	0.00	0.00	0.00 32	0.00 32	0.00
Photocell A (0.0032-1) Cell B (µA) - Current level of											
Cell A (µA) - Current level of	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limiting (None, Low, High) - Ignored Plasma Int. changes	Lo	No ne	Lo	Lo	Lo	Lo	Lo	No ne	Lo	Lo	No
renresents Plasma Intensity Normalize (s) - I ime I-60k to normalize Plasma Intensity	20	10	20	20	20	20	20	10	20	20	10
Normalize (DIV) - Level 0-10	3	3	3	3	3	3	n	3	3	c	5
.01 .6.1. 6.6.6.5. 5.1.1.1) msD	1		1	1	1	1		-	1		
A/B; Bias DC+, DC-)	B/A	B/ A	B/A	B/A	B/A	B/A	B/ A	B/	B/A	B/ A	B/
Timer (s)	180	30	240	240	240	240	09	30	240	180	30
He flow (secm) - MFC#4	10	10	10	10	10	10	10	10	10	10	
50sccm C2F6 - MFC#2 SF6 flow (sccm) - MFC#3	12	12	12	12	12	12	12	12	12	12	
O2 adjusted flow (seem) -											31.
throngh metering valve (seem) -	f 7	f 2	J	f 7	J	f 7	f 7	f	J	f 7	J.
(P°) Clean Channel (on, off) - U2	P Of J	Of f	of f	7 Of	JO 6	JO 6	of f	JO f	J 61	8 Of	Of f
Lower Electrode Temperature	18 18		61 61	18 17	19 19	61 61	18 17		1 61	18 18	
Anring etch (DIV) max Upper Electrode Temperature	3. 1		3. 1	3. 1	3. 1	3. 1	3. 1		3. 1	3. 1	
DC Self-Bias Voltage (V)  Lindpoint measured level	- 19 5		3.	3.	· %. ∞				5.3	- 19	
01-9DV	9 6		8 8	15	15	15	41 6		4 8	41 6	
avg, RF Power (W) Reflected RF Power (W)	15 0	0	15	15 0	15	15 0	15	0	15 0	15 0	0
fwd. CW RF Power (W)	15	0	15	15	15	15	15	0	0	15	0
MKS Baratron 127A (mTorr)	40		40	40	40	40	40		40	40	
MKS Baratron 127A (mTorr) WKS Baratron 127A (mTorr) Measured Working Pressure -	40	40	40	40	0 0	40	0 0	40 0	40	40	22 5
Sensor Find: D. Plasma-Timer: Pumpdown Pressure - MKS - NKS - MKS -		50						50			50
B:Pumpdown; C:Plasma- SensorEnd: D:Plasma-Timer:	D, E, F	В, D	D, E, F	D, E, F	D, E, F	D, E, F	D, E,	B, D	D, E, F	D, E,	B, D,
Recipe Number		13						13			14
Masking layer material - Resist, metal,		S18 22						S18 22			Non
Targeted layer for etching		Si						Si			Si
Date		13/11/						13/11/			13/11/
<b>Sample or Recipe name</b>		TSoi- 15N						TSoi- 19N			Si- substr ate

	<b>⊢</b>					1
Comments	Strip of TSoi- 13bN, 13bN, TSoi- 14bN, TSoi- 14cN, TSoi- 15N, and		Plasma clean prior to CNT growth for these witness	Plasma Strip before Wet Strip and CNT Growth		so
	Strip of TSoi- 13bN, TSoi- 14bN, TSoi- 14cN, TSoi- TSoi- 15N,and		Plasma clean prior to CNT growth for these withess samples	Plasma Strip before Wet Stri and CN Growth		Tests
#3 (nm) +Target -Mask						
#2 (nm) +Target -Mask Dektak measured height at step						
Dektak measured height at step						
Dektak measured height at step #1 (nm) +Target -Mask						
Etch iteration #		1	1	0	1	0
Vent Time (s)		20	20		50	
sa rot av			3 2		ε,	
Pressure (mTorr) 0-5k Number of Purges (1-9) - with		50	20		50	
Furge Pumpdown threshold				_		_
Cell B (µA) - Current level of Photocell B (0.0032-1)		0.00	0.00	0.00	0.00	0.00
(1-2500.0) A Iloootoda						
Cell A (µA) - Current level of		0.00	0.00	32	0.00	0.00
Ignored Plasma Int. changes		No	No ne	No	No	No
normalize Plasma Intensity - Low, High) -		10 1	10 r	10 N	10 r	10 r
represents Plasma Intensity Normalize (s) - Time 1-60k to						
Mormalize (UIV) - Level 0-10		5	5	5	S	v
.01 ,C.\ ,C, C, C, C, L, (1, 1) misə		-1	1	1		1
A/B; Bias DC+, DC-)		B/ A	B/ A	B/ A	B/ A	B/ P
Timer (s)		300	300	30	180	30
He flow (secm) - MFC#4						
SF6 flow (seem) - MFC#3						
MPC#1 O2 adjusted flow (seem) - \$50seem C2F6 - MPC#2		31.	31.	31.	31.	31.
CHF3 = Freon23 flow (seem) -						
Clean Channel (on, off) - U2		JO f	Of f	J f	Of f	Of f
Lower Electrode Temperature		19	19		19	
Auring efteh (MV) max Upper Electrode I emperature (O)		20	18		20	
Endpoint measured level during etch (VIA)		2.	1.		1.8	
DC Self-Bias Voltage (V)		- 12 1	- 12 1		- 12 1	
01-52A		52	53		53	
avg, RF Power (W)  Reflected RF Power (W)		90	50	0	50	0
fwd. CW RF Power (W)		50 3	50 5	0	50	0
MKS Baratron 127A (mTorr)						
MKS Baratron 127A (mTorr) Measured Working Pressure -		22	5	5 5	22 5	->
Baratron 127A (mTorr) Working Pressure Setpoint -		22 5	22 5	22 5	22	22 5
SensorEnd: P.Plasma-Timer: Pumpdown Pressure - MKS -				50		50
B:Pumpdown; C:Plasma-		D, E, F	E, E, D	B, D,	D, F,	B, D,
Recipe Number				14		14
Masking layer material - Resist, metal,				Non		Non
Targeted layer for etching				S18 22		Si
Date						13/11/
Sample or Recipe name			S160N ; S162b N	TSoi- 13bN; TSoi- 14bN; TSoi- 14cN; TSoi- 15N; TSoi- 15N;		Si- substr ate

Comments		t ma p ore r r wth		Dektak measure ment after postbake				
		Last Plasma Strip before CNT Growth		Dektak measur ment after postbal				
433 - Marget - Mask								
#2 (nm) +Target -Mask Dektak measured height at step								
Dektak measured height at step								
Dektak measured height at step #1 (nm) +Target -Mask								
Etch iteration #	1	0	1	0	1	2	3	4
Vent Time (s)	20		20		20	20	20	20
name - (C-1) 25g in 1 to 15dinuyi	3		3		3	3	3	3
Manager of Purges (1-9) - With	50		50		50	50	50	50
Photocell B (0.0032-1) Purge Pumpdown threshold		0		0				
Cell B (µA) - Current level of	0.00	0.00	0.00	0.00	_	_	_	_
Cell A (µA) - Current level of Photocell A (0.0032-1)	0.00	0.00	0.00	0.00	_	-	_	_
Limiting (None, Low, High) - Ignored Plasma Int. changes	No ne	No ne	No ne	No	Lo w	Lo w	Lo w	Lo
vizanatal emzel azilemaon	10	10	10	10	20	20	20	20
renresents Plasma Intensity Normalize (s) - Time 1-60k to	5	5	5	3	3			3
Normalize (UIV) - Level 0-10			1		1		1	
A/B; Bias DC+, DC-) Gain (1, 1.5, 2, 5.5, 5, 7.5, 10,	~ .	33.7	<u>~ 1</u>		/8/	× 1	× 1	
( ) and ( ) and ( )	O B	A B	D B	- A	$\frac{B'}{A}$	) B,	A B	0 A
Timer (s)	300	30	009	30	120	120	09	120
He flow (seem) - MFC#4				25	25	25	25	25
SF6 flow (seem) - MFC#3				5	5	5	5	5
MFC#1 O2 adjusted flow (sccm) - 50sccm C2F6 - MFC#2	31.	31.	31.					
through metering valve				10	10	10	10	10
Clean Channel (on, off) - U2	Of f	of f	JO f	J f	J J	JO f	JO f	Of f
Lower Electrode Temperature	18		19	18	18	19	19	19
during efth (DIV) max Upper Electrode Temperature	18		20	18	18	20	20	18
Endpoint measured level	2		1.		3.	3.	3.	3.
DC Self-Bias Voltage (V)	5. 5.		- 12 2		۰ % ∞	3.5	3.	- 22 7
Keflected KF Power (W) -	53		52		14 9	14 9	14	15 6
avg. RF Power (W)	50	0	50	0	15	15	15	15
fwd. CW RF Power (W)	50	0	50	0	15	15	15	15
MKS Baratron 127A (mTorr)	24	5 5	22 5	30	30	30	30	30
MKS Baratron 1274 (mTorr) Measured Working Pressure -	22 2	5 5	22 5	30 3	30	30	30	30
Baratron 127A (mTorr) Working Pressure Setpoint -		50 2	(4	50   3	01	(.)	(.)	(-)
SensorEnd: P.Plasma-Timer: Pumpdown Pressure - MKS -	Ç H, H	B, 5	E,	B, 5	<b>(</b> 55	<b>6</b> 55	Ç H. H.	<b>6</b> 55
Recipe Number  B:Pumpdown; C:Plasma-	I E		I E		I E E	I E	I E	D, E, E
Resist, metal,		14		3 15				
Masking layer material -		Non		S18 13				
Targeted layer for etching		S18 22		TiN				
Date				13/12/				
Sample or Recipe name		TSoi- 13bN; TSoi- 14bN; TSoi- 14cN; TSoi- 15N; TSoi- 15N;		TSoi-				

Comments	Dektak measure ment after the TiN etch + 1 st Dry PR stripping below. TiN etch was based on visual inspectio n and was clearly too long as Si substrate is surely etched underneat h exposed TiN which was roughly 100nm. TiN/Si etch rate is roughly 100nm. TiN/Si etch rate in (average	Dektak
#3 (nm) +Target -Mask	707	
#2 (nm) +Target -Mask Dektak measured height at step		$\vdash$
Dektak measured height at step	613	
#1 (nm) +Target -Mask	891	
Dektak measured height at step	<u>∞</u>	$\vdash$
Etch iteration #	N	0
(e) əmiT ənəV	20	
Pressure (mTorr) (1-5k Number of Purges (1-9) - with N2 for 2s	ю	
Purge Pumpdown threshold	20	
Photocell B (0.0032-1)	<del>-</del>	0.00
Cell B (µA) - Current level of		Ö
Cell A (µA) - Current level of Photocell A (0.0032-1)	_	0.00
Ignored Plasma Int. changes	_	+
Limiting (None, Low, High) -	Lo w	No
or Moo-1 Shift - (8) Sanahilovi	20	10
represents Plana Intensity Normalize (s) - I ime I-60k to	S	3
Mormalize (UIV) - Level U-10	_	$\Box$
.01 .c. .ccc2 .c.1 .1) misə		H
A/B; Bias DC+, DC-)	B B	A
(s) Timer	120	30
He flow (secm) - MFC#4	25	25
SF6 flow (seem) - MFC#3	v	5
O2 adjusted flow (secm) - 50scem C2F6 - MFC#2		
throngh metering valve - (HF3 = Freon23 flow (seem) -	10	10
	Of	Of
Clean Channel (on, off) - U2	19	18
Lower Electrode Temperature	18	∞
Apper Electrode Lemperature		$\vdash$
Endpoint measured level	က် က	Н
DC Self-Bias Voltage (V)	' ઌ૽ ∞	Ш
Keflected KF Power (W) - ACG-10	6 6	
avg. RF Power (W)	0 0	0
fwd. CW RF Power (W)	115	0
MKS Baratron 127A (mTorr)	330	30
Measured Working Pressure -		_
Baratron 127A (mTorr) Working Pressure Setpoint -	30	30
SensorEnd: D.Plasma-Timer: Fumpdown Pressure - MKS -		50
B:Pumpdown; C:Plasma- SensorEnd: D:Plasma-Timer:	D, F	В,
Recipe Number		15
Resist, metal,		∞
Masking layer material -		S1
Targeted layer for etching		LiN
appa		
Date		13/12/
<b>Sample or Recipe пате</b>		TSoi-

	o 0				o o o as as //
Comments	measure ment after postbake				Dektak measure ment after the TiN etch + 1st Dry PR stripping below. TiN etch was based on visual inspectio n and was clearly too long as Si substrate is surely etched underneat h exposed TiN
#3 (mm) +Target -Mask	ппв				
Dektak measured height at step					546
#2 (mm) +Target -Mask					470
#1 (nm) +Target -Mask Dektak measured height at step					
Dektak measured height at step					509
Etch iteration #		1	2	3	4
(e) smiT InsV		20	20	20	20
Number of Purges (1-9) - with		3	3	3	$\epsilon$
Purge Pumpdown threshold Pressure (mTorr) 0-5k Number of Purges (1-9) - with		50	50	50	50
Photocell B (0.0032-1)	0.1				
Cell B (µA) - Current level of	32	1	_	1	-
Cell A (µA) - Current level of Photocell A (0.0032-1)	32	1	1	1	7-
Ignored Plasma Int. changes	ne	Lo	Lo	Lo	~ «
normalize Plasma Intensity - Low, High) -	1				
Normalize (s) - Time 1-60k to		20	20	20	50
Normalize (UIV) - Level 0-10		3	3	3	п
.01 ,6.7 ,6 ,6.5 ,2 ,6.1 ,1) mra		1	1	1	_
A/B; Bias DC+, DC-)		B/ A	B/ A	B/ A	B/A
Timer (s)		120	120	120	120
He flow (seem) - MFC#4		25	25	25	25
SF6 flow (seem) - MFC#3		5	5	5	Ŋ
50sccm C2F6 - MFC#2					
O2 adjusted flow (seem) -		(			
throngh metering valve - (seem) -		10	10	10	01
Clean Channel (on, off) - O2	J	Of f	Of f	Of f	of f
Lower Electrode Temperature		19	18	18	18
during eftch (DIV) max Upper Electrode 1 emperature		18	18	18	18
Endpoint measured level Auring etch (VIO)		3.	3.	3.	છે. છ
DC Self-Bias Voltage (V)		3.	- %	- 22 3	' ഗ്∞
01-9⊃∀		14 9	9	9	6
avg, RF Power (W)  Reflected RF Power (W)					
		5 15 0	5 15 0	5 15 0	0 0
MKS Baratron 127A (mTorr) fwd, CW RF Power (W)		15	15	15	115
MKS Baratron 127A (mTorr) Measured Working Pressure -	c.	30	30	30	3
	0	30	30	30	0 0
Working Pressure Setpoint -					
Pumpdown Pressure - MKS -	Q	D, F,	E, F	D, F,	D,
Recipe Number  B: Fumpdown; C: Plasma-					
Resist, metal,					
- Masking layer material -	13				
Targeted layer for etching					
Date	03				
Sample or Recipe name	11b				

Comments	which was roughly 100m. TiN/Si etch rate is roughly 64nm/mi n n (average 508/8min ).	Dektak measure ment after postbake				Dektak measure ment after the TiN etch + 1 st Dry PR stripping below. TiN etch
Dektak measured height at step #3 (nm) +Target -Mask						
#2 (nm) +Target -Mask						551
#1 (nm) +Target -Mask Dektak measured height at step						628 5
Dektak measured height at step						
Etch iteration #		0	-	2	3	4
SC not SM  (s) smiT tneV			20	20	20	50
Pressure (mTorr) 0-5k Number of Purges (1-9) - with			3	3	3	3
Purge Pumpdown threshold			50	50	50	50
Cell B (µA) - Current level of Photocell B (0.0032-1)		0.00	←	~	~	~
(1-2800.0) A Iləsotodq		2 20				
To level of (km) - Current level of		0.00			1	-
Limiting (None, Low, High) - Ignored Plasma Int. changes		No	Low	Lo	Lo	r Vo
represents Plasma Intensity Normalize (s) - I ime 1-60k to normalize Plasma Intensity		10	20	20	20	20
Mormalize (DIV) - Level 0-10		3	3	3	3	ю
.01, 6.7, 6, 6.5, 5, 10, 11) msd		1	1	1	1	1
A/B; Bias DC+, DC-)		А	B/ A	B/ A	B/ A	B/ A
Timer (s)		30	120	120	120	120
He flow (seem) - MFC#4		25	25	25	25	25
SF6 flow (seem) - MFC#3		5	5	5	5	N
Suscem C2F6 - MFC#2						
CHES - Freeness now (seem) - O2 adjusted flow (seem) -		10	10	10	10	10
Clean Channel (on, on) - Oz		Of f	Of f	Of f	Of f	Of f
Clean Channel (on, off) - U2		18	19	18	18	18
Tower Electrode Temperature Opportugies 1 emperature		18	18	18	18	18
Endpoint measured level during etch (DIV) max Upper Electrode 1 emperature			3.	3.	3.	3.
DC Self-Bias Voltage (V)			3.	3.	- 22 3	. %.∞
Keflected KF Power (W) - ACG-10			14 9	14 9	14 9	15 6
avg. RF Power (W)		0	15	15	15	15 0
fwd. CW RF Power (W)		0	15	15	15	15 0
MKS Baratron 127A (mTorr)		30	30	30	30	30
Working Pressure Setpoint - MKS Baratron 1274 (mTorr)		30	30	30	30	30
Raratrop 1274 (m.Torr) Working Pressure Setpoint -		50				
B:Pumpdown; C:Plasma- SensorEnd: D:Plasma-Timer: Fumpdown Pressure - MKS -		B,	E, E,	E, E,	D, F,	E, E,
Recipe Number		15				
Masking layer material - Resist, metal,		S18 13				
Targeted layer for etching		Tin				
Date		13/12/				
Sample or Recipe name		TSoi- 12				

Comments	based on visual inspectio in and was clearly too long as Si substrate is surely etched undermeat h exposed TiN which was roughly 100nm. TiN/Si etch rate is roughly 1,00nm. In n and (average 590/8min).	Dektak measure ment after postbake			
#33 (nm) +Target -Mask					
#2 (nm) +Target -Mask Dektak measured height at step					H
#1 (nm) +Target -Mask Dektak measured height at step					Ш
Dektak measured height at step					
Etch iteration #		0	1	2	3
Vent Time (s)			20	20	20
Pressure (mTorr) 0-5k Number of Purges (I-9) - with \$\infty\$ for \$\infty\$			3	3	3
Pressure (mTorr) 0-5k			50	50	50
(1-2£00.0) B (1-2£00.0)		0.00	_	_	~
Cell B (µA) - Current level of					Н
Cell A (µA) - Current level of Photocell A (0.0032-1)		0.00	~	_	-
Ignored Plasma Int. changes		No ne	Lo	Lo	Lo
normalize Plasma Intensity - (MgiH, Wod, Low, High) -					$\blacksquare$
represents Plasma Intensity Normalize (s) - Time 1-60k to		10	20	20	20
Normalize (UIV) - Level 0-10		3	3	3	3
.01 .6.1. 6.6.6.5. 5.1.0.1 msD			1	1	-
A/B; Bias DC+, DC-)		Y	B/ A	B/ A	B/
Timer (s)		30	120	120	120
He flow (seem) - MFC#4		25	25	25	25
SF6 flow (seem) - MFC#3		S	5	5	5
Suscem C2F6 - MFC#2					
OZ adjusted flow (sccm) -		10	10	10	10
through metering valve		Of f	J f	JO f	JO
Clean Channel (on, off) - UZ		18	19	17	18
Lower Electrode Temperature		18	20	18	18
Endpoint measured level Upper Electrode I emperature			3.	3.	3.
DC Self-Bias Voltage (V)			3.	- %. %	1
01-93¥			15	14 9	15
avg, RF Power (W) Reflected RF Power (W)		0	15	15	15
fwd. CW RF Power (W)		0	0	0	.5
MKS Baratron 127A (mTorr)		30	30 1	30 1	30 1
MKS Baratron 1274 (mTorr)					
Raratron 1274 (mTorr) - Vorking Pressure Setpoint -		0 0	30	30	30
Sensor End: Plasma-Timer: Pumpdown Pressure - MKS -		, 50	٠, ٠,	-6 6.	
B:Pumpdown; C:Plasma-		D, B,	J. H.	D E F	D,
Resist, metal, Recipe Number		15			Н
Masking layer material -		S18 13			
Targeted layer for etching		TiN			
Date		13/12/			
Sample or Recipe name		TSoi- 12b			

Comments		Dektak measure ment after the TiN etch + 1st Dry PR stripping below. TiN etch was based on visual inspectio n and was clearly too long as Si substrate is surely etched underneat h exposed TiN was roughly 100nm. TiN/Si etch rate is roughly 65nm/mi n
#3 (nm) +Target -Mask		511
#2 (nm) +Target -Mask Dektak measured height at step		
Dektak measured height at step		507
#1 (nm) +Target -Mask		534
Dektak measured height at step		
Etch iteration #		4
(e) SmiT TineV		50
Presente (mTorr) (1-5k him - (e-1) sagnu TorradmuN 2C rof CV		8
Purge Pumpdown threshold Pressure (mTorr) 0-5k		20
Photocell B (0.0032-1)		
Cell B (µA) - Current level of		7
(I-2£00.0) A llasotod4		_
To level terrent level of		-
Limiting (None, Low, High) - Ignored Plasma Int. changes	W	r w
normalize Plasma Intensity		20
vienesents Plasma Internation 1-60k to		
Normalize (UIV) - Level 0-10		ro -
.01 .c./ .c .c.c (c.1 ,1) mra		Г
A/B; Bias DC+, DC-)	A	<b>∀</b>
Timer (s)		120
He flow (seem) - MFC#4		2.5
SF6 flow (seem) - MFC#3		v
50sccm C2F6 - MFC#2		
O2 adjusted flow (seem) -		110
through metering valve (Secm) -		
Clean Channel (on, off) - O2	J	of f
Lower Electrode Temperature		8
during efth (DIV) max Upper Electrode Temperature		18
Endpoint measured level	-	<del>د،</del> «۱
DC Self-Bias Voltage (V)	%.∞	' v, ∞
VCG-10	9	9
avg, RF Power (W) Reflected RF Power (W)		0 0
	0	
MKS Baratron 127A (mTorr) fwd, CW RF Power (W)	0	0 0
MKS Baratron 127A (mTorr) Measured Working Pressure -	3	3
	0	0 0
Raratron 1274 (m.Torr) Working Pressure Setpoint		
Sensor Frad. P. Plasma-Timer.	편교	B,
Recipe Number  B:Pumpdown; C:Plasma-		
Resist, metal,		
- Masking layer material -		
Targeted layer for etching		
Date		
Sample or Recipe name		

	e 9				e e e h h h h h h h h h h h h h h h h h
Comments	Dektak measure ment after postbake				Dektak measure ment after the TiiN etch + 1st Dry PR stripping below. TinN etch was based on visual inspectio n and was clearly
#3 (nm) +Target -Mask	1 1 2 1				753 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
#2 (nm) +Target -Mask Dektak measured height at step					
#1 (nm) +Target -Mask Dektak measured height at step					637
Dektak measured height at step					619
Etch iteration #	0	1	2	3	4
Vent Time (s)		20	20	20	20
Pressure (mTorr) 0-5k Number of Purges (1-9) - with \$5 rof \$2		3	3	3	т
Pressure (manage Punge Pung Punge Punge Pung Pung Pung Pung Pung Pung Pung Pung		50	50	50	50
Cell B (µA) - Current level of Photocell B (0.0032-1)	0.00	1	1	1	-
Cell A (µA) - Current level of Photocell A (0.0032-1)	0.00	1	1	1	<del>-</del>
Limiting (None, Low, High) - Ignored Plasma Int. changes	 No	Lo w	Lo w	Lo w	k «
vtienatul emeeld azilemaon	10	20	20	20	50
Normalize (s) - Lime 1-60k to	3	3	3	3	m ·
Gam (1, 1, 5, 5, 5, 5, 7, 5, 10, 15) of the Input	1	1	1	1	-1
A/B; Bias DC+, DC-)	A	B/ A	B/ A	B/ A	A A
Timer (s)	30	120	120	120	120
He flow (secm) - MFC#4	25	25	25	25	25
SF6 flow (seem) - MFC#3	5	5	5	5	8
O2 adjusted flow (sccm) - 50sccm C2F6 - MFC#2					_
throngh metering valve (seem) -	f 10	f 10	f 10	f 10	f 10
Clean Channel (on, off) - U2	Of f	JO t	, Of f	of f	f J
Lower Electrode Temperature	3 18	) 19	17	3 18	18
Apper Electrode Temperature	18	20	18	18	18
Endpoint measured level		3.	3.	3.	
ACG-10 DC Self-Bias Voltage (V)		3.	. %		' m' ∞
Keflected KF Power (W) -		15	14	15	15
avg. RF Power (W)	0	15	15	15	0 0
MKS Baratron 127A (mTorr) fwd, CW RF Power (W)	0	15	15	15	15
MKS Baratron 1274 (mTorr) Measured Working Pressure -	30	30	30	30	30
Working Pressure Setpoint -	30	30	30	30	30
Pumpdown Pressure - MKS -	50				
B:Pumpdown; C:Plasma-	B, D	D, F,	D, E,	D, E,	E, D
Recipe Number	15				
Masking layer material - Resist, metal,	S18 13				
Targeted layer for etching	Tin				
Date	13/12/				
<b>Sample or Recipe пате</b>	TSoi- 18				

Comments	too long	substrate s surely	etched	n exposed FiN	which	oughly	TiN/Si	etch rate is roughly	36nm/mi 1	(average	3.50% outility ).
#3 (nm) +Target -Mask		. 32 1									
Dektak measured height at step											
#2 (nm) +Target -Mask											
Dektak measured height at step											
#1 (mm) +Target -Mask											
Dektak measured height at step											
Etch iteration #											
(e) amiT tnaV											
SC 301 CV											
Pressure (mTorr) 0-5k Almber of Purges (1-9) - with											
Purge Pumpdown threshold											
Photocell B (0.0032-1)											
Cell B (µA) - Current level of											
Photocell A (0.0032-1)											
Cell A (µA) - Current level of											
Ignored Plasma Int. changes		_	_		_		_	_			_
Limiting (None, Low, High) -											
Yenresents Plasma Intensity Normalize (s) - Time I-60k to											
					_			_			
Vormalize (VIV) - Level U-10											
.01 .c./ .c .c.c .2 .c.1 .1) misə											
A/B; Bias DC+, DC-)											
Timer (s)											
He flow (seem) - MFC#4											
SF6 flow (seem) - MFC#3											
- Complexed flow (seem) - 50seem C2F6 - MFC#2											
MEC#1											
through metering valve  - (HF) = Freont's flow (seem) -											
Clean Channel (on, off) - O2											
Lower Electrode Temperature											
Upper Electrode Lemperature											
Endpoint measured level											
DC Self-Bias Voltage (V)											
01-93V											
Keffected KF Power (W) -											
avg. RF Power (W)											
fwd. CW RF Power (W)											
MKS Baratron 127A (mTorr)											
MKS Baratron 1274 (mTorr) Measured Working Pressure -											
Baratron 127A (mTorr) Working Pressure Setpoint -											
SensorEnd: D.Plasma-Timer: Fumpdown Pressure - MKS -											
B:Pumpdown; C:Plasma- SensorEnd: D:Plasma-Timer:											
Recipe Number											
Resist, metal,											
Masking layer material -											
Targeted layer for etching											
эзкП											
Sample or Recipe name											

Plasmionique Inc.

# Annex 1G: Microwave Plasma ashing/stripping with PLASMA-PREEN II-973 system

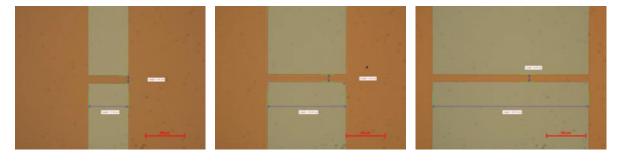
соттепт	New Pyrex Bell Jar + Rubber Gasket received. Old Jar was found to have scratches on its sealing edge with the gasket. The old gasket shows black spots (burnt?)	5.5 hours of pumping	5.5 hours of pumping	4 hours of pumping, Bell jar temperature is around 85degC after the run	Bell jar temperature is around 112degC after the run	Bell jar temperature is around 87degC after the run. Flow-Pressure relation is weird so rely on the pressure for future use since precision on flow is not good. Plasma more stable but less luminous	Verification of the Flow-Pressure relation.	Verification of the Flow-Pressure relation.	Test		The goal is to remove popped/burnt PR spots that could not be removed with wet and RIE strip					Popped/Burnt PR spots are not removed by the MW plasma strip neither. However This treatment/cleaning might have played a role in conditioning the Ni layer and Ni-TiN interaction for the later observed aligned CNT growth on CTSoi-14N broken Bridge#3!
Fan Cooling Time (min)				30	20				15	15	15	15	120	10	10	10
Cooking Time (min)				15	15	15			15	15	15	15	15	15	15	15
W002 si %001 bns W001 si %0				420	420	420			420	420	420	420	420	420	420	420
Knob (%) 0% is 100W and colling (%) 0% is 100W and				%08	%08	%08			%08	%08	%08	%08	%08	%08	%08	%08
Measured Working Pressure - Hastings/Teledyne (Torr)				3.6	2.93	4.34	5.82	3.2	3.7	3.73	3.7	3.63	3.7	3.7	3.7	3.7
O2 flow - Gas B (SCFH) (1 SCFH = 471,95 seem)				3	2	2.5	3	2	3	3	3	3	3	3	3	33
1) (ACFH) (ACFH) AT 10w - Gas A (SCFH) (SCFH = 471.95 seem)																
Gas B Regulator Pressure (PSI) (LPSI = 51.715 Torr)		25	25	25	25	25			25	25	25	25	25	25	25	25
Gas A Regulator Pressure (PSI) (LPSI = 51.715 Torr)																
Pumpdown Base Pressure - Hastings/Teledyne (Torr)		0.78	0.78	0.77	92.0	0.76			0.78	0.78	0.78	0.78	8.0	8.0	8.0	0.8
HASKRIS water circulator		47	47	47	47	47 (			46		46					
Keep in 0,3-25 GPM range;		9,00	0,65	9,0	9,0	9,00			9,0		9,0					
Circuit #1 (CVC Sputter)		Closed (			Closed	Closed			Closed		Closed (					
HASKRIS water circulator			Closed	Closed												
(9F) : Keep below 120° F;		89	89	89	89	89			89		89					
Heat Sink (HS), Glass Plate		HS	HS	HS	HS	HS			HS	HS	HS	HS	GP	GP	GP	GP
Targeted PR layer for stripping		None	None	None	None	None			S1822		S1822					
Etch iteration #				1	2	3			1	2	1	2	3	4	2	9
Date	13/11/01	13/11/04	13/11/05	13/11/06					13/12/06		13/12/06		13/12/09			

Sample CTSoi-14N

Annex 2: Sample CTSoi-14N

Bridge1 Bridge2 Bridge3

# TiN Patterning

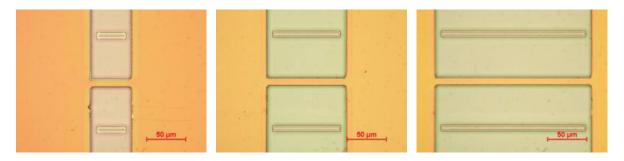


Lithography + Wet etch (ok!) + Strip (Wet)

# Si Etching



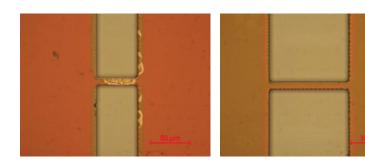
Lithography, Development

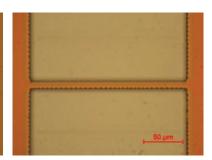


Plasma etch (RIE)

# Sample CTSoi-14N

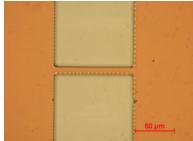
# SiO2 etching





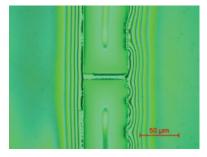
Wet Etch (BHF, HF)

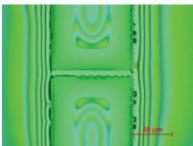


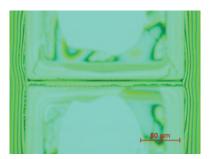




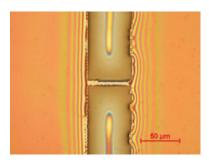
Strip (RIE + Wet)

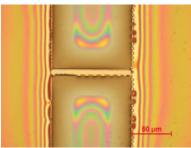


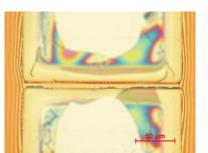




Lithography, Development #5 (HMDS + Negative PR with double coat+development)

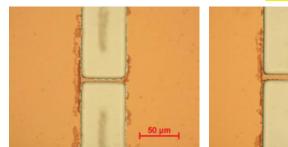


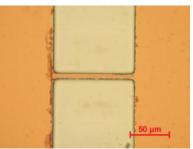


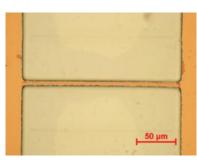


Flood Exposure (stabilizes PR for PVD process)

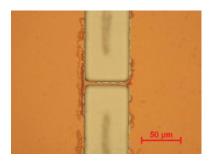
#### Sample CTSoi-14N

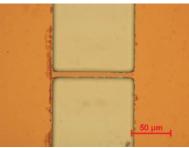


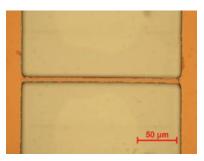




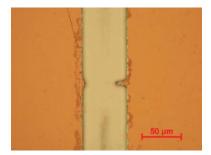
Strip (Wet + RIE + Gentle Q-tip scrub removal) #5e. Popped/Burnt PR spots still visible: add MW plasma strip with multi-step process? Is Bridge#3 broken during Q-tip scrubbing step?

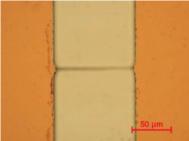


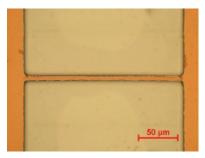




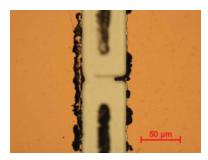
Strip (MW Plasma, 6 runs of 15 min) #6e. Popped/Burnt PR spots not removed by the MW plasma strip.

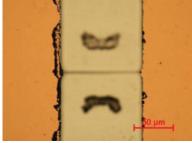


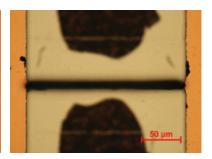




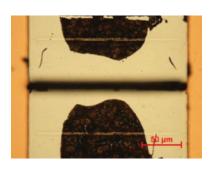
Strip (Wet + Gentle Q-tip scrub removal). Bridge#1 and Bridge#2 collapsed.

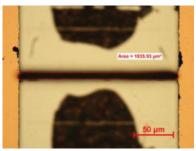


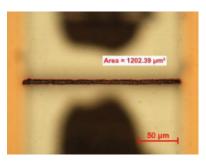




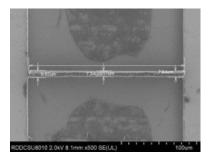
Page 56 / **C** of **D** 

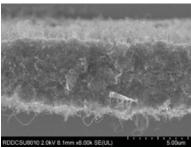




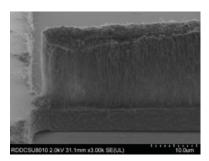


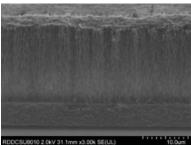
Bridge#3 - Optical images: Dimensions - Focus on Si handle (left), TiN surface (center), and CNT tip (right) for thickness estimation.

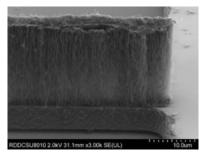




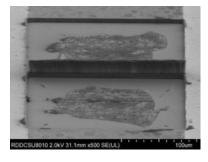
Bridge#3 - SEM images (No tilt): Dimensions

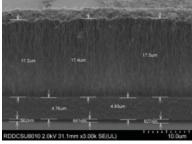


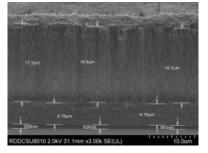




Bridge#3 - SEM images (70° tilt): Broken end (left), middle part (center), and holding end (right).







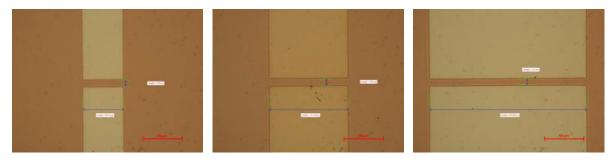
Bridge#3 - SEM images (70° tilt): Dimensions (uncorrected)

#### Sample CTSoi-13bN

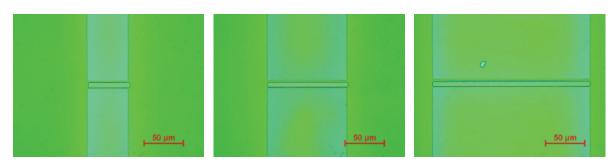
Annex 3: Sample CTSoi-13bN

Bridge1 Bridge2 Bridge3

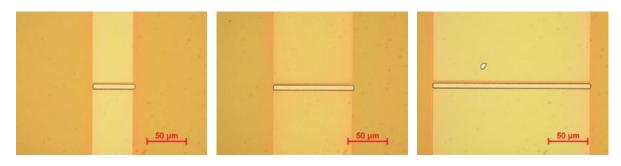
#### **TiN Patterning**



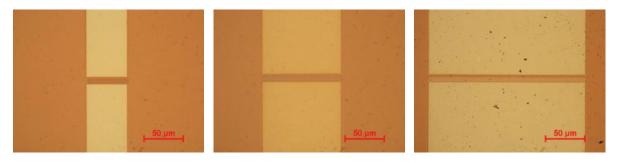
Lithography + Wet etch (ok?) + Strip (Wet) : TiN step thickness seems OK (no extra etch needed)



Lithography (HMDS + Negative PR with double coat) + Development. #5

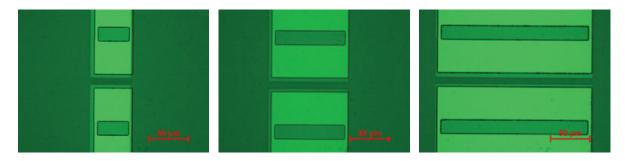


Flood Exposure (stabilizes PR for PVD process)

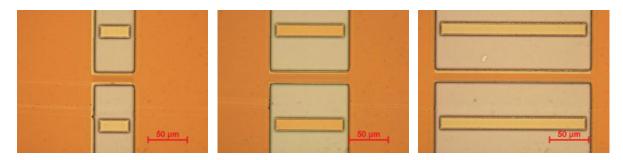


Strip (Wet + Gentle Q-tip scrub removal + RIE)x2 after Postbaking (oven), Descumming, and Ni coating. Page 57 /  $\bf A$  of  $\bf C$ 

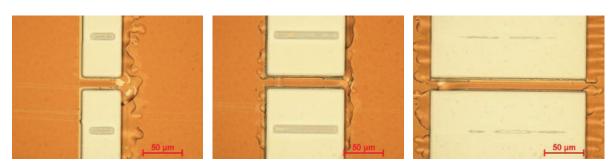
# Si Etching



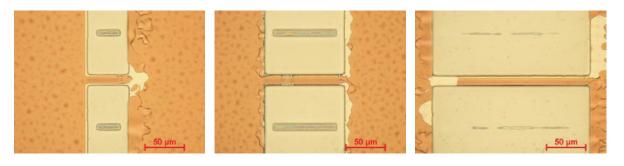
Lithography, Development



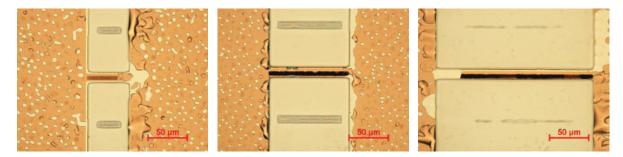
Plasma etch (RIE)



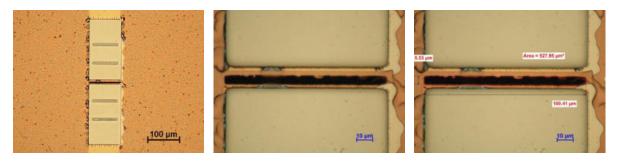
Wet Etch (BHF) #30: underetching of TiN



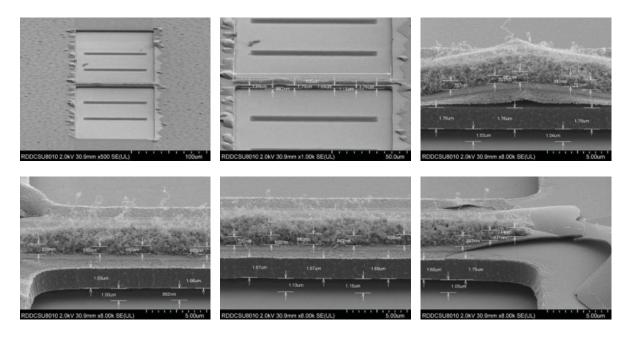
Strip (RIE + Wet)



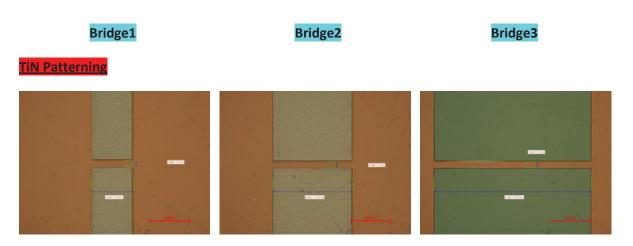
Optical images



Bridge#2 - Optical images: Dimensions

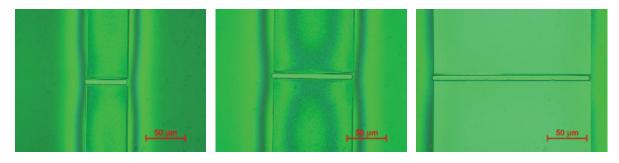


Bridge#1 - SEM images (70° tilt): Dimensions (uncorrected)

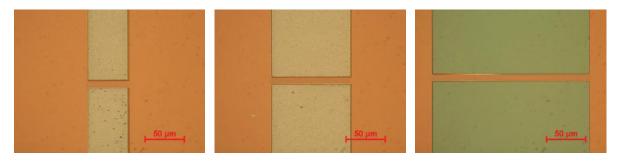


Lithography + Wet etch (APM, #8, stopped due to apparent but not real Si etch!, No Si device layer was present at Bridge#3 location due to thinning) + Strip (Wet) : TiN step thickness seems too low  $\rightarrow$  + Lithography + Plasma etch (RIE recipe for TiN etches Si as well  $\rightarrow$  no endpoint) + Strip (RIE + Wet)

#### Ni Lift-off



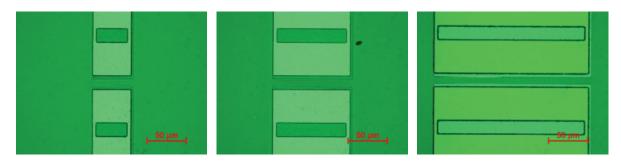
Lithography (HMDS + Negative PR with double coat) + Development(#2)



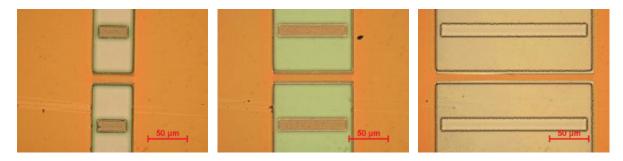
Strip (Wet + Gentle Q-tip scrub removal + RIE) #2 after Flood Exposure, Postbaking (oven), Descumming, and Ni coating.

# Sample CTSoi-14bN

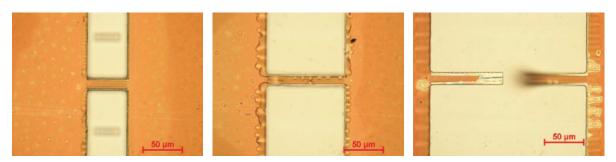
# Si Etching



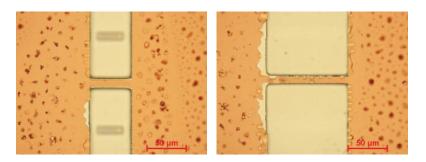
Lithography, Development (#3)



Plasma etch (RIE) #3

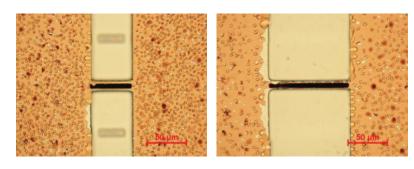


Wet Etch (BHF) #28: underetching of TiN

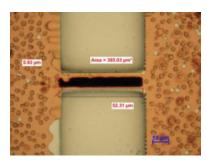


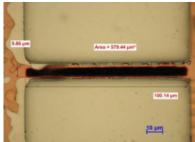
Strip (RIE + Wet + RIE)

# Sample CTSoi-14bN

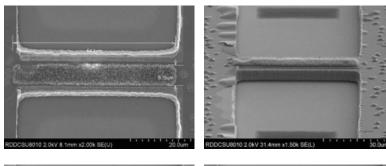


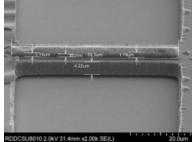
Optical images

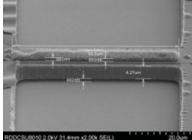


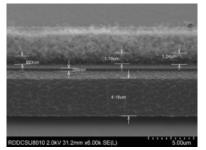


Optical images: Dimensions



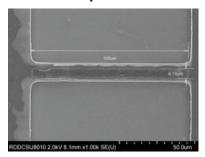


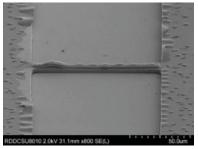


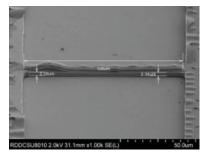


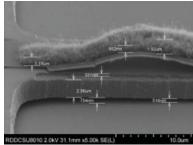
Bridge#1 - SEM images (70° tilt, except #1): Dimensions (uncorrected)

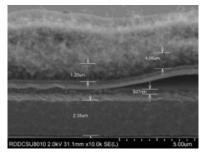
# Sample CTSoi-14bN











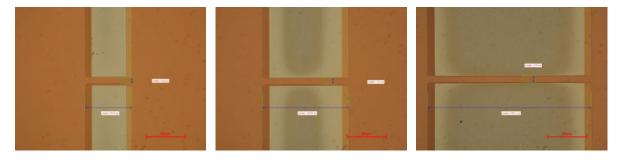
Bridge#2 - SEM images (70° tilt, except #1): Dimensions (uncorrected). Bridge#2 touches the Si handle!

Sample CTSoi-14cN

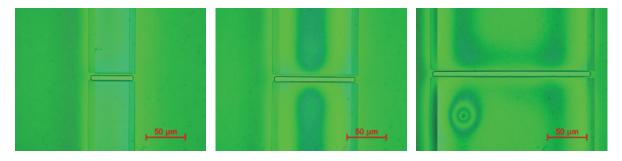
Annex 5: Sample CTSoi-14cN

Bridge1 Bridge2 Bridge3

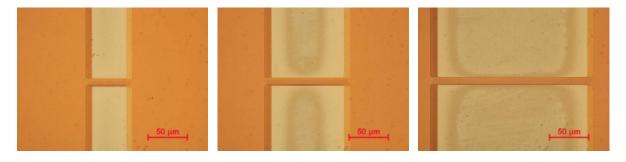
#### **TiN Patterning**



Lithography + Wet etch (APM, #5, stopped due to apparent but not real Si etch!) + Strip (Wet) : TiN step thickness seems too low  $\rightarrow$  + Lithography #4 + Plasma etch (RIE recipe for TiN etches Si as well  $\rightarrow$  no endpoint) + Strip (RIE + Wet) #2



Lithography (HMDS + Negative PR with double coat) + Development #2



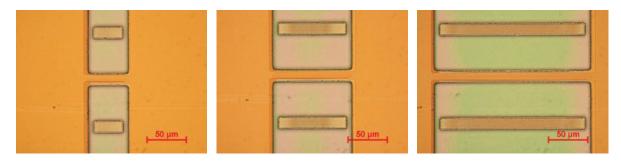
Strip (Wet + Gentle Q-tip scrub removal + RIE) #2 after Flood Exposure, Postbaking (oven), Descumming, and Ni coating.

# Sample CTSoi-14cN

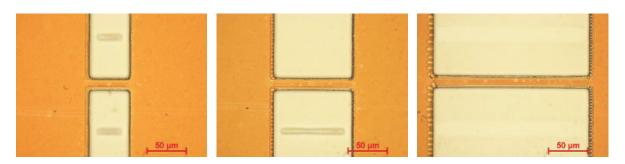
# Si Etching



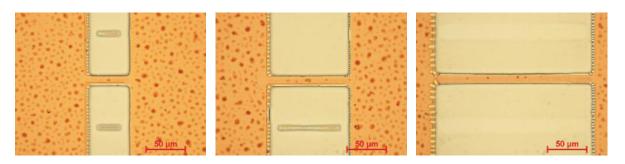
Lithography, Development



Plasma etch (RIE) #3

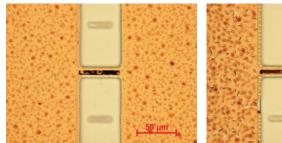


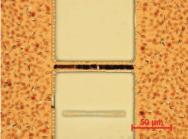
Wet Etch (BHF) #33: less underetching of TiN



Strip (RIE + Wet + RIE)

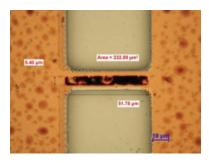
# Sample CTSoi-14cN

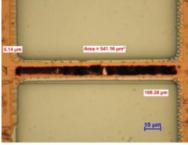


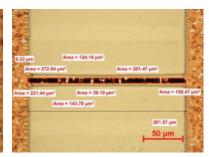




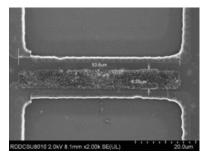
Optical images



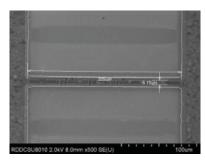




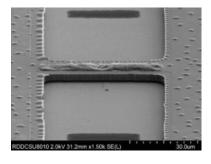
Optical images: Dimensions

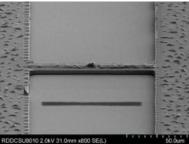


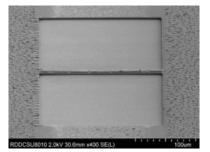




SEM images: Dimensions







# Plasmionique Inc. Sample CTSoi-14cN

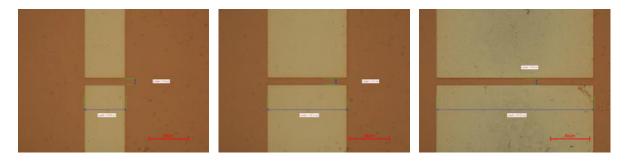
SEM images (65° tilt): Dimensions (uncorrected). Bridge#3 touches the Si handle!

Sample CTSoi-15N

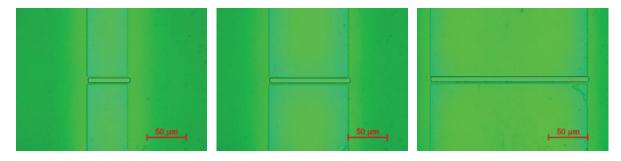
Annex 6: Sample CTSoi-15N

Bridge1 Bridge2 Bridge3

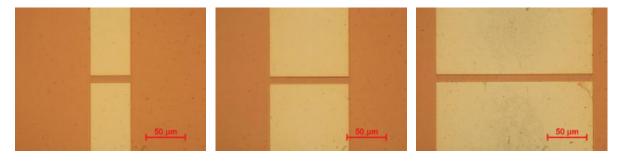
#### **TiN Patterning**



Lithography + Wet etch (APM, #5, stopped due to apparent but not real Si etch!) + Strip (Wet) : TiN step thickness seems too low  $\rightarrow$  + Lithography + Plasma etch (RIE recipe for TiN etches Si as well  $\rightarrow$  no endpoint) + Strip (RIE + Wet) #2



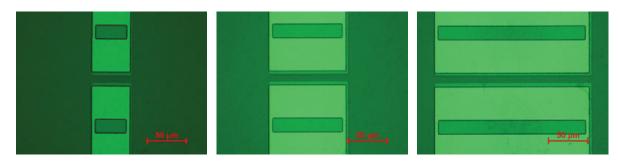
Lithography (HMDS + Negative PR with double coat) + Development #2



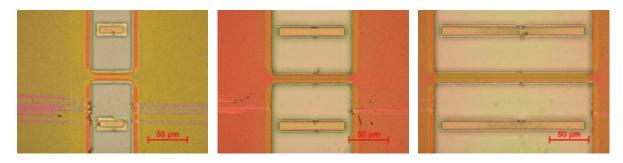
Strip (Wet + Gentle Q-tip scrub removal + RIE) #4 after Flood Exposure, Postbaking (oven), Descumming, and Ni coating.

# Sample CTSoi-15N

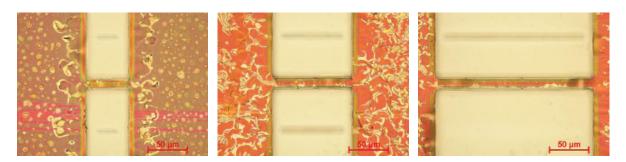
# Si Etching



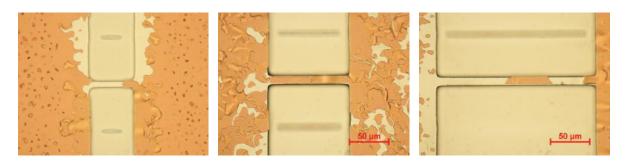
Lithography, Development



Plasma etch (RIE) #5

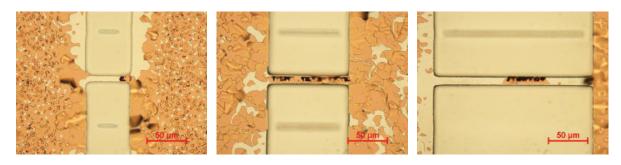


Wet Etch (BHF) #40: underetching of TiN

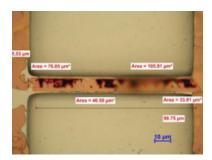


Strip (RIE + Wet + RIE)

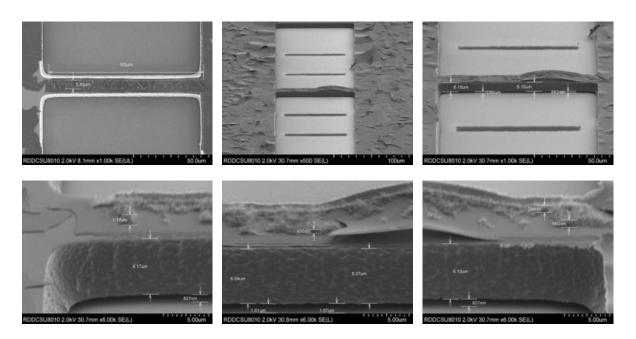
# Sample CTSoi-15N



Optical images



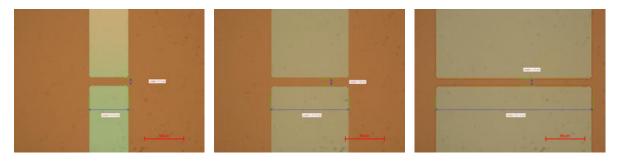
Bridge#2 - Optical image: Dimensions



Bridge#2 - SEM images (65° tilt, except #1): Dimensions (uncorrected). TiN connection might become problematic!

Bridge1 Bridge2 Bridge3

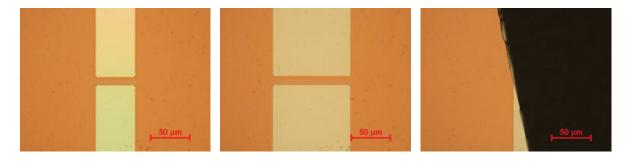
#### **TiN Patterning**



Lithography + Wet etch (ok?) + Strip (Wet) : TiN step thickness seems OK (no extra etch needed)



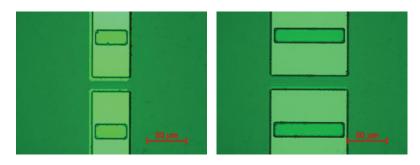
Lithography (HMDS + Negative PR with double coat) + Development (#2)



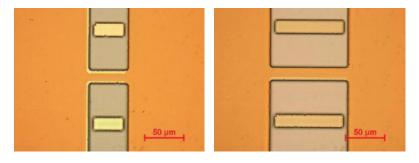
Strip (Wet + Gentle Q-tip scrub removal + RIE) #2 after Flood Exposure, Postbaking (oven), Descumming, and Ni coating. Sample broken at Bridge#3

# Sample CTSoi-19N

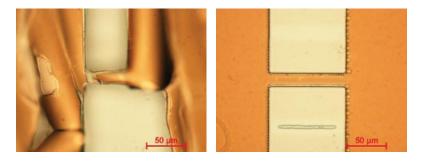
# Si Etching



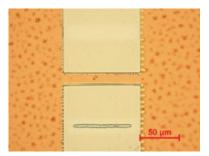
Lithography, Development



Plasma etch (RIE) #2



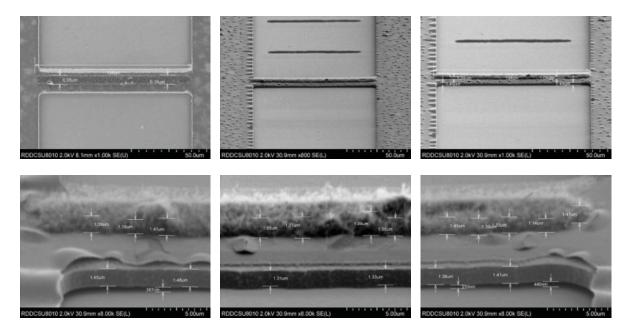
Wet Etch (BHF) #42: severe underetching of TiN at Bridge#1



Strip (RIE + Wet + RIE)



Bridge#2 - Optical images + Dimensions



Bridge#2 - SEM images (65° tilt, except #1): Dimensions (uncorrected).